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COST ANALYSIS OF THE MILITARY MEDICAL CARE SYSTEM: DATA, COST FUNCTIONS, AND PEACETIME CARE

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January 1994

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Office of the Director (Program Analysis and Evaluation)

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In response to a congressional request, the DoD is conducting a comprehensive review of its military medical care system. IDA has been tasked with analyzing the cost of DoD's in-house medical facilities, under both current policies and proposed alternatives. This paper describes the data used in the analysis and the cost functions that were estimated. The paper also assesses the in-house costs of two policy alternatives for the provision of medical care during peacetime.

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PREFACE

This paper was prepared by the Institute for Defense Analyses (IDA) for the Office of the Director (Program Analysis and Evaluation) under a task entitled "Cost Analysis of the Military Medical Care System." The objective of the task is to analyze the cost of U.S. military medical care facilities under current policies and under proposed alternatives. This paper partially fulfills that objective by describing the data used in the analysis, explaining the cost functions that were estimated, and assessing the in-house costs of two alternatives for peacetime medical care.

This paper was reviewed by Thomas P. Christie, Thomas P. Frazier, Christopher Jehn and Katherine L. Railey.

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I. INTRODUCTION AND SUMMARY

A. BACKGROUND

Section 733 of the National Defense Authorization Act for Fiscal Years 1992 and 1993 directed the DoD to conduct "a systematic review of the military medical care system required to support the Armed Forces *during a war or other conflict*, and any adjustments to that system required to provide *cost-effective health care in peacetime to covered beneficiaries*." [Emphasis added.][1] To satisfy this mandate, the DoD contracted with several organizations, among them the Institute for Defense Analyses (IDA). Under two separate task orders, IDA is conducting a survey of military health-care beneficiaries, and a cost analysis of military hospitals. The results of the survey analysis are reported in a companion paper.[2] The methodology behind the cost analysis was described in a previous paper.[3] The current paper reports most of the findings of the cost-analysis task. Additional findings and supporting documentation will be provided in a subsequent paper.

The motivation behind the congressional concern is illustrated by reference to Figure I-1. DoD medical expenditures may be roughly measured by the medical program elements in Major Force Program 8 of the Future Years Defense Program (FYDP).[4] Measured against the right-hand scale, medical expenditures have grown steadily, reaching about $14 billion by fiscal year (FY) 1991. This growth has persisted even in light of the reductions in weapon-system procurement observed during the late 1980s. It might be

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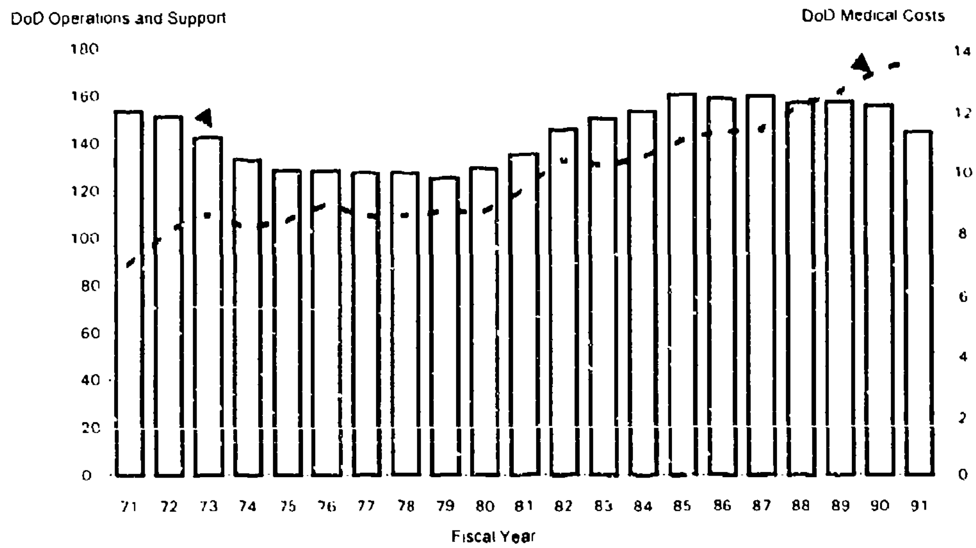
1 United States House of Representatives, "National Defense Authorization Act for Fiscal Years 1992 and 1993," Conference Report, Report 102-311, November 13, 1991, Section 733, pp. 123-126.

2 Philip M. Lurie, Karen W. Tyson, Michael L. Fineberg, Larry A. Waisanen, James A. Lee, James A. Roberts, Mark E. Sieffert, and Bette S. Mahoney, "Analysis of the 1992 DoD Survey of Military Medical Care Beneficiaries," Institute for Defense Analyses, Paper P-2937, forthcoming, January 1994.

3 Matthew S. Goldberg, Thomas P. Frazier, Timothy J. Graves, Stanley A. Horowitz, Stephen K. Welman, Kathryn L. Wilson, and Joseph-Paul Wilusz, "Cost Analysis of the Military Medical Care System: An Interim Report," Institute for Defense Analyses, Paper P-2850, June 1993.

4 It is possible to construct more comprehensive measures of medical expenditures, which consider Major Force Programs other than just Program 8 (Training, Medical, and Other General Personnel Activities). Indeed, IDA has constructed such measures, and they will be discussed in a subsequent IDA paper. For examining aggregate trends, however, expenditures in Program 8 are sufficient.

argued that weapon-system procurement does not provide a proper basis of comparison for medical expenditures, because such expenditures are driven more by the existing force structure than by new procurement. Therefore, we have displayed for comparison not the total DoD budget, but rather the total operations and support cost (on the left-hand scale), defined as operations and maintenance plus military personnel cost. Even relative to this more stable baseline, the share accounted for by medical expenditures has shown a dramatic increase.



Note. Costs are in billions of FY92 dollars.

Figure I-1. DoD Trend Analysis: Operations and Support Versus Medical Costs

The increase in medical expenditures largely parallels that observed in the civilian sector.[5] One partial explanation is common to both sectors: the introduction of new, expensive technology for diagnosis and treatment of disease. In addition, both sectors are subject to demographic changes that may drive even larger cost growth in the future. For example, retired military personnel are eligible for medical care within Military Treatment Facilities (MTFs) on a space-available basis. Retired military personnel under age 65 are also eligible for DoD-sponsored care from civilian providers under the Civilian Health and

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5 The literature is voluminous; one recent example is Burton A. Weisbrod, "The Health Care Quadrilemma: An Essay on Technology Change, Insurance, Quality of Care, and Cost Containment," *Journal of Economic Literature*, Vol. 29 (June 1991), pp. 523-552.

Medical Program of the Uniformed Services (CHAMPUS). Although the size of the active-duty force is being reduced, the population of retired personnel is projected to remain relatively stable; moreover, retired personnel have longer life expectancies than ever before. Figure I-2 displays official OASD (Health Affairs) projections of trends in the beneficiary population. According to these projections, the number of active-duty medical beneficiaries will decrease from 2.05 million in FY92 to 1.78 million in FY98, a 13% cumulative decline. However, the number of retired beneficiaries under age 65 will decline only slightly over the same period, from 1.16 million to 1.09 million.

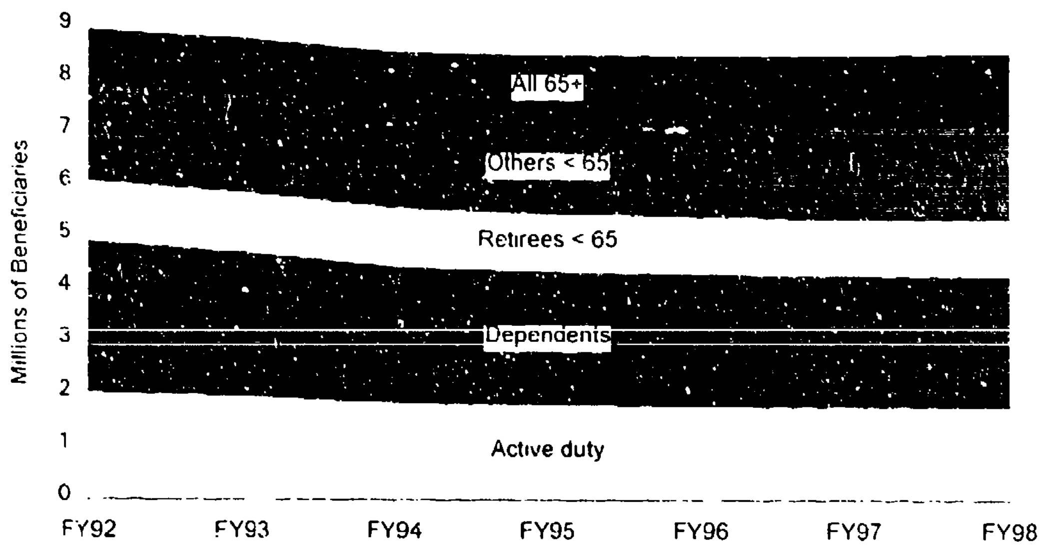

Figure I-2. Trends in Beneficiary Population

B. THE SECTION 733 STUDY

Careful analysis is required to isolate the major components of cost growth in military medicine: trends in the beneficiary population, trends in per-capita utilization, trends in unit cost that are common to both the military and civilian sectors, and differential trends in unit cost between the military and civilian sectors. To best analyze the components of cost growth, DoD has formed several internal working groups and contracted with outside organizations, including IDA. The Section 733 Study is being coordinated by the Director, Program Analysis and Evaluation (PA&E). He chairs a Steering Committee consisting of the Assistant Secretary of Defense for Health Affairs, the

Assistant Secretary of Defense for Personnel and Readiness (P&R), the Assistant Secretary of Defense for Reserve Affairs, the DoD Comptroller, the Joint Staff Director for Logistics (J-4), and representatives of the three Service Secretaries.

The team structure that supports the Steering Committee is illustrated in Table I-1. The survey of beneficiaries was directed by an internal working group, chaired by an official from OASD (P&R). The IDA Survey-Analysis Team designed the survey questionnaire, developed the sampling plan, and analyzed the survey responses. Technical support to the IDA Survey-Analysis Team was provided by the Defense Manpower Data Center (DMDC), which is an element of OASD (P&R). In particular, DMDC fielded the survey and coded the survey responses.

Table I-1. Assignment of Tasks

Organization	Task Description
Beneficiary Survey Working Group [OASD (P&R)]	Survey of beneficiaries
IDA Survey-Analysis Team	Survey of beneficiaries (questionnaire, sampling plan, analysis)
Defense Manpower Data Center	Survey of beneficiaries (fielding, coding of responses)
Peacetime Alternatives and Costs Working Group [OD (PA&E)]	Design, cost analysis of peacetime alternatives
IDA Cost-Analysis Team	Cost analysis of in-house medical system
RAND Corporation	Utilization and civilian cost projections (largely based on survey data)
Wartime Medical Requirements Working Group [OD (PA&E)]	Wartime medical requirements
OASD (Health Affairs)	Other medical issues

The cost analysis was directed by an internal working group, chaired by an official from OD (PA&E). The current paper documents the efforts of the IDA Cost-Analysis Team, charged with estimating the costs of in-house medical care. The RAND Corporation is charged with projecting peacetime health-care utilization under several analytical cases. These cases involve either increasing or decreasing the number of MTFs, plus a variety of contractual arrangements to obtain care fo[illegible] beneficiaries from the civilian sector. RAND's utilization analysis is largely b[illegible] analysis of the survey developed by IDA. In turn, RAND's utilization analys[illegible] the basis for IDA's

estimation of in-house medical costs. RAND is responsible for estimating the cost of civilian-sector care under each analytical case.

The development of wartime medical requirements was directed by an internal working group, chaired by an official from OD (PA&E). Finally, a team within OASD (Health Affairs) is examining other medical issues raised in the congressional language.

The relationships among the various teams are further illustrated in Figure I-3. As shown in the lower left-hand portion of the figure, the IDA Survey-Analysis Team designed the survey questionnaire. Some questions were contributed by RAND, with an eye toward its utilization analysis. Once the IDA Survey-Analysis Team completed both the survey questionnaire and the sampling plan, DMDC performed the actual fielding of the survey and coding of the responses. The raw survey database was then returned to IDA, where the data were "cleaned" (i.e., screened for inconsistent responses). The IDA Survey-Analysis Team also augmented the data, by merging it via Social Security numbers with administrative data on military sponsors. The cleaned and augmented data were then passed to RAND for its utilization analysis.

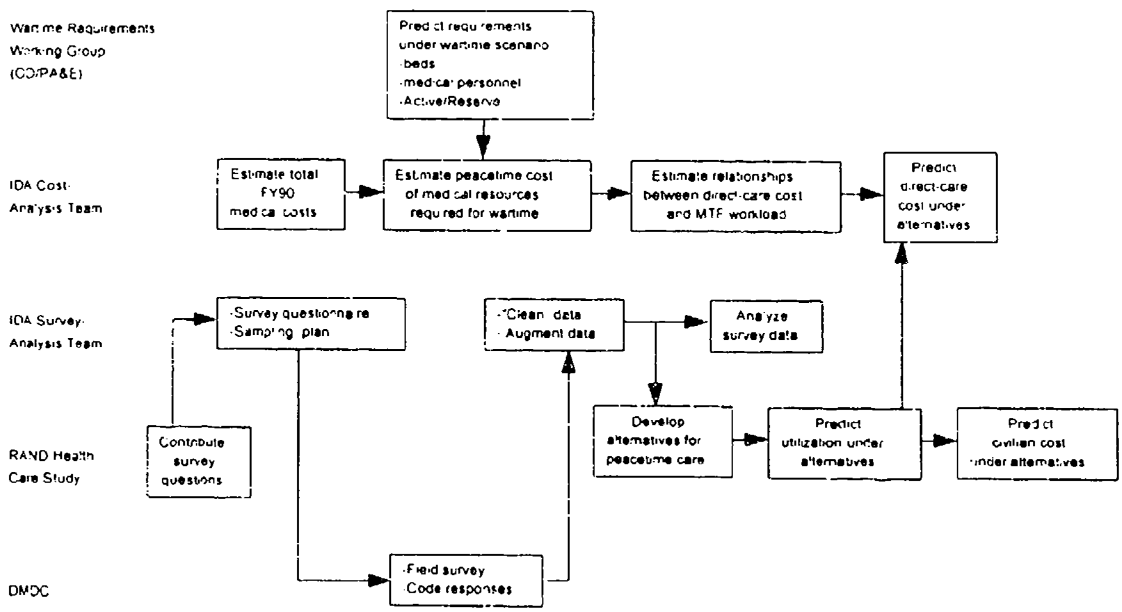

Figure I-3. Information Flow on the 733 Study

The upper portion of Figure I-3 describes the activities of the IDA Cost-Analysis Team. The first task was to estimate total medical expenditures in the FY90 FYDP. Primarily, this task involved identifying medical expenditures outside of Major Force Program 8 (Training, Medical, and Other General Personnel Activities). The second task was to estimate the portion of the total that represents the peacetime cost of the medical resources required for wartime. The wartime requirements, expressed as numbers of beds (by Service, theater, and echelon of care) and medical personnel (by Service, medical specialty, and Active or Reserve component) were provided by the OD (PA&E) Wartime Requirements Working Group. The findings of these two IDA tasks will be documented in subsequent IDA papers.

The current paper reports on the final two tasks of the IDA Cost-Analysis Team: estimating regression relationships between medical workload and cost at MTFs, and predicting MTF costs under each analytical case. Although the tasks appear separable, the first two tasks delimit the last two tasks in the following way: the analytical cases must preserve sufficient in-house medical resources, even during peacetime, to meet the wartime medical demand. Therefore, cost-effectiveness criteria are applied only to the portion of in-house medical resources above that required for wartime.

C. DATA AND COST MODELS

Chapters II and III describe the regression models that IDA has developed to relate cost and workload at MTFs. The primary data source is the Medical Expense and Performance Reporting System (MEPRS). It is important to recognize that MEPRS is not a patient-level cost-accounting system. Instead, MEPRS reports cost and workload within a three-digit hierarchical chart of accounts, corresponding to workcenters within an MTF. MEPRS includes the costs of materials and supplies, plus military, civilian, and contract personnel. In addition, MEPRS includes a depreciation allowance for purchases of modernization and replacement equipment.

In order to compare the cost-effectiveness of in-house medical care versus medical care purchased from the civilian sector, the same set of cost elements must be present on both sides of the ledger. We investigated six areas in which MEPRS potentially omits or understates cost elements required for comparability with the civilian sector: (1) base

operations and real property maintenance, (2) management headquarters, (3) facilities construction, (4) central automation support, (5) military personnel pay, and (6) MEPRS Special Programs accounts. The understatement of costs proved significant in all but areas (1) and (5). Table I-2 shows the factors that we developed to adjust for the understatement of costs. These factors are specific to Service branch and inpatient versus ambulatory care. The factors range between 10.6% and 16.9%, and are described in detail in Chapter II.

Table I-2. MEPRS Adjustment Factors

Service Branch	Inpatient Expenses	Ambulatory Expenses
Army	16.9%	13.2%
Air Force	12.8%	10.6%
Navy	13.3%	11.2%

Chapter III develops the MTF cost models used to project the cost of inpatient and ambulatory care under each analytical case. The models project cost at each individual facility given levels of inpatient and ambulatory workload, physical capacity measured in terms of operating beds, and the volume of Graduate Medical Education (GME) activity. The facility-level costs are then summed over all facilities to estimate the system-wide costs of providing care at military hospitals under each analytical case. Costs of providing care within the civilian sector, and paid through CHAMPUS, will be separately estimated by the RAND Corporation.

The cost models reveal a constant marginal cost of about $3,000 per inpatient discharge from medical centers. The marginal cost per discharge from community hospitals is not a constant; instead, it decreases for the larger hospitals, which exhibit returns to scale. Similarly, the marginal cost of an ambulatory visit is constant for medical centers, constant (at a higher level) for stand-alone clinics, but decreasing for the larger community hospitals. The cost models also contain estimates of the cost per additional operating bed, and the cost per additional resident or intern enrolled in a hospital's GME program.

D. COST ESTIMATES FOR THE ANALYTICAL CASES

The Section 733 Study has thus far examined two analytical cases for the provision of peacetime care.[6] Under both cases, MTF capacity is increased by the addition of 784 operating beds at 14 existing hospitals, plus the construction of a new 94-bed hospital at Ft. McPherson, Georgia. The analytical cases would provide access to MTFs for individuals who currently must use CHAMPUS.

The difference between the two analytical cases rests in the rate at which MTF workload replaces CHAMPUS workload. Under the first case, workload is drawn into MTFs at a one-to-one rate, so that total (i.e., MTF plus CHAMPUS) workload is held constant. This case resolves to a pure efficiency comparison between care provided in MTFs and care purchased through CHAMPUS. Under the second case, it is recognized that the increase in MTF workload probably exceeds the reduction in CHAMPUS workload, because beneficiaries respond to the lower co-payments in MTFs. Total cost is higher under this case, which reflects an increase in demand for medical care as well as an efficiency comparison.

Cost estimates for the analytical cases are presented in Chapter IV. The increased in-house cost of moving from the current system to the first case described above is $265 million or 4.2%. Computation of the *net* change in total cost requires an estimate of the corresponding reduction in CHAMPUS cost, which is found in the RAND Corporation publication. The full movement to the second case, recognizing the increase in total workload, is an additional $206 million or 3.2%. The overall increase in cost is rather modest, because the increase in 878 operating beds represents only about 7% of the FY92 capacity of roughly 12,000 operating beds in the continental United States (CONUS) plus Alaska and Hawaii.

Future analysis will consider analytical cases that reduce as well as those that increase MTF capacity. For cases that reduce MTF capacity, care must be exercised to preserve sufficient capacity to meet the wartime medical requirements. The wartime requirements specify not only numbers of CONUS evacuation beds, but also numbers of physicians (by specialty) to treat casualties and disease non-battle injuries (DNBI) in the

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6 A detailed description of the analytical cases is found in Susan D. Hosek, Bruce W. Bennett, Kimberly A. McGuigan, Jan M. Hanley, Roger Madison, and Afshin Rastegar. "The Demand for Military Health Care: Supporting Research for a Comprehensive Study of the Military Health Care System," RAND Corporation, MR-407-PA&E, January 1994.

theater. The CONUS hospitals must be configured in peacetime with enough billets to occupy all of the wartime-required physicians that will be drawn from the Active Component. In addition, the beneficiary population served by the remaining CONUS hospitals must supply enough clinical material to keep these physicians fully trained. The construction of analytical cases along these lines is now underway, and the cost estimates will be provided in the near future.

II. DATA DESCRIPTION

The Medical Expense and Performance Reporting System (MEPRS) is the primary data source on cost and workload at Military Treatment Facilities (MTFs). This chapter first provides a general description of MEPRS. Next, some adjustments to the MEPRS data are developed. In order to compare the cost-effectiveness of in-house medical care versus medical care purchased from the civilian sector, the same set of cost elements must be included on both sides of the ledger. Prices charged by civilian-sector providers reflect all elements of cost, including corporate overhead, inter-divisional transfer, and amortization of real property. Because MEPRS was designed for a different purpose than were commercial cost-accounting systems, some of these cost elements are missing from MEPRS. The adjustments developed in this chapter are critical to allow a fair comparison with medical costs charged in the civilian sector.

We made every effort to be conservative in developing the adjustments to MEPRS. That is, we included additional cost elements only when we could clearly justify them as comparable to costs charged in the civilian sector. Moreover, we included cost elements only when we could clearly identify them with DoD's peacetime health-care mission, as opposed to its wartime readiness mission. Having made the MEPRS adjustments, we assess their impact by comparing the reported and adjusted costs for FY92. Finally, we close the chapter by identifying the sources for the few remaining data elements outside of MEPRS.

A. MEPRS COST AND WORKLOAD DATA

According to the MEPRS manual:[1]

> The purpose of the Medical Expense and Performance Reporting System (MEPRS) for DoD Medical Operations is to provide consistent principles, standards, policies, definitions, and requirements for accounting and

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[1] "Medical Expense and Performance Reporting System for Fixed Military Medical and Dental Treatment Facilities," Office of the Assistant Secretary of Defense (Health Affairs), Publication DoD 6010.13M, January 1991, p. 1.3.

reporting of expense, manpower, and performance by DoD fixed military medical facilities. Within these specific objectives the MEPRS also provides in detail: uniform performance indicators; common expense classification by work centers; uniform reporting of personnel utilization data by work centers; and a cost assignment methodology.

Before describing in detail what MEPRS *is*, it is useful to describe what MEPRS is *not*. First, MEPRS is *not* the hospital commander's annual budget. Some cost elements in MEPRS are "non-reimbursable" meaning that, although the hospital makes a cost estimate, no funds are actually spent from the hospital commander's budget. Instead, the hospital receives services "free," usually from the host military base. Examples include fire and police protection and snow removal provided by the host base. Similarly, MEPRS entries for depreciation do not represent current-year outlays. The link between MEPRS expenses and Future Years Defense Program (FYDP) obligations is further clouded because, depending on the type of appropriation, obligated funds may translate into outlays (and thus appear in MEPRS) over a multi-year time window. None of these observations are intended as pejorative, because MEPRS was designed for a different purpose than the budgeting system.

Along these lines, it is critical to recognize that MEPRS is *not* a patient-level cost-accounting system: MEPRS *cannot* be used to directly estimate the cost of performing a particular procedure on a particular patient. The DoD has not yet seen the need to develop a patient-level accounting system, because patients are not billed individually for medical services provided in-house. Although this observation may appear startling at first, we should point out that Kaiser Permanente does not bill patients individually either, nor do they have a patient-level accounting system. Instead, they set premiums for large groups of patients by relating aggregate cost experience to summary demographic and epidemiological characteristics.

Given these limitations, we will now describe procedures for indirectly estimating unit cost at MTFs (i.e., cost per inpatient discharge or cost per ambulatory visit) based on MEPRS data. MEPRS reports cost and workload within a three-digit hierarchical chart of accounts. The entire set of one-digit account codes is shown in Table II-1, along with an illustrative partial set of two-digit and three-digit account codes. Costs are available at any of these three levels of aggregation: the two-digit cost is the sum of its constituent three-digit costs; similarly, the one-digit cost is the sum of its constituent two-digit costs. Our regression modeling was conducted at the one-digit level of aggregation (e.g., Inpatient

and Ambulatory). However, we examined costs down to the three-digit level in order to better understand the data system, and to develop adjustment factors where necessary.

Table II-1. Partial List of MEPRS Account Codes

MEPRS Account Code	Account Title	Status
A	Inpatient	final operating account
AA	Medical Care	final operating account
AAA	Internal Medicine	final operating account
AAB	Cardiology	final operating account
AAC	Coronary Care	final operating account
AAD	Dermatology	final operating account
AAE	Endocrinology	final operating account
AAF	Gastroenterology	final operating account
AAG	Hematology	final operating account
AAH	Intensive Care	final operating account
AAI	Nephrology	final operating account
AAJ	Neurology	final operating account
AAK	Oncology	final operating account
AAL	Pulmonary	final operating account
AAM	Rheumatology	final operating account
AAN	Physical Medicine	final operating account
AAO	Clinical Immunology	final operating account
AAP	HIV (AIDS)	final operating account
AAQ	Bone Marrow Transplant	final operating account
AAR	Infectious Disease	final operating account
AAS	Allergy	final operating account
AAZ	Other Medical Care	final operating account
AB	Surgical Care	final operating account
AC	Obstetrical/Gynecological Care	final operating account
AD	Pediatric Care	final operating account
AE	Orthopedic Care	final operating account
AF	Psychiatric Care	final operating account
AG	Family Practice Care	final operating account
B	Ambulatory	final operating account
C	Dental	final operating account
D	Ancillary	**intermediate operating account**
E	Support	**intermediate operating account**
F	Special Programs	final operating account

The Ancillary and Support accounts are labeled "intermediate operating accounts," indicating that the costs are "stepped-down" or allocated to the final operating accounts.

For example, costs in ancillary account DFA (Anesthesiology) are stepped-down to the final operating accounts based on the minutes of service provided to each receiving account. Similarly, costs in support account EFA (Housekeeping) are stepped-down based on the square footage cleaned for each receiving account. The step-down procedure is hard-wired into MEPRS, so that the costs in final operating accounts are available to analysts only post-stepdown, not pre-stepdown.

MEPRS includes costs in four major categories: materials, supplies, depreciation, and personnel. Materials and supplies should be interpreted broadly to include all non-personnel Operations and Maintenance expenses funded through the following program elements: 0807711 (Care in Regional Defense Facilities), 0807714 (Other Medical Activities), 0807715 (Dental Care Activities), 0807790 (Audio-Visual Activities, Medical), and 0807792 (Station Hospitals and Clinics).[2]

MEPRS includes a depreciation allowance for purchases, funded through the Other Procurement appropriation, of modernization and replacement equipment in excess of a dollar threshold. The threshold is increased periodically to reflect price inflation. Depreciation is taken on a straight-line basis over eight years. Depreciation allowances are assigned as indirect expenses during the step-down process, rather than being directly assigned to a work center upon acquisition.

Personnel are classified by skill category: clinicians (i.e., physicians and dentists), direct-care professionals, direct-care paraprofessionals, registered nurses, and administrative/clerical/logistical personnel. Personnel are further classified by type: officer, enlisted, civilian, contract, and other. Timesheets are used to allocate personnel time across three-digit MEPRS accounts. Within each three-digit account, personnel expenses are then estimated by multiplying full-time equivalents (FTEs) times standard pay factors, which are specific to both skill category and personnel type.

Each three-digit MEPRS account has its own measure of workload performed. As already indicated, the D (Ancillary) and E (Support) accounts have workload measures, such as square feet, that facilitate stepping-down their costs to the final operating accounts. The workload measures for the A (Inpatient) accounts are dispositions and occupied bed days. The workload measure for the B (Ambulatory) accounts is the number of visits.

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2 See "Medical Expense and Performance Reporting System for Fixed Military Medical and Dental Treatment Facilities," p. 3.6.

B. ADJUSTMENTS TO MEPRS COST DATA

We made several adjustments for cost elements that are undercounted or, in some cases, completely ignored in MEPRS. We made these adjustments to allow a fair comparison with medical costs charged in the civilian sector, recognizing that MEPRS was not designed to include all of the cost elements found in commercial cost-accounting systems. Many of the adjustments were based on a side-by-side comparison between subsets of MEPRS and corresponding subsets of the FYDP. Other adjustments relied upon comparisons between MEPRS data for the three Services, with one Service acting as the benchmark for the other two. This section develops and justifies the various adjustments that were made, based primarily on FY90 MEPRS data.

1. Base Operations and Real Property Maintenance

Of the MTFs in the continental United States (CONUS), all but seven reside on a host military base. The seven stand-alone MTFs are as follows. Walter Reed Army Medical Center (AMC), Fitzsimons AMC, National Naval Medical Center (NNMC) Bethesda, Naval Hospital (NH) Oakland, NH Portsmouth, NH San Diego, and NH Beaufort. For all but these seven, a considerable portion of base operations and real property maintenance activity (RPMA) is provided by the host base. Among the services provided by the host base are: utilities, property maintenance, minor construction, transportation, and fire and police protection. The purpose of this section is to determine whether support services provided by the host base are adequately reflected in MEPRS, or whether some adjustment in necessary.

Base operations and RPMA are reflected in MEPRS in one of three ways. If the hospital transfers funds to the host base in return for services provided, then the services are deemed "reimbursable." The amount of money transferred appears in the two-digit ED account of MEPRS (Support Services, Funded or Reimbursable). If the hospital receives services but does not transfer any funds, then the services are deemed "non-reimbursable." In this instance, the hospital makes an estimate of the value of services received, and reports this estimate in the EC account of MEPRS (Support Services, Non-reimbursable). Although the basis for the estimate varies by detailed three-digit cost element, the most common basis is the number of square feet within the hospital. Finally, housekeeping costs are sometimes grouped together with base operations and RPMA. Military hospitals pay for all of their own housekeeping, and these costs are reported in the EF account of MEPRS (Housekeeping).

The Defense Business Operations Fund (DBOF) was introduced, though not fully implemented, in FY92. The effect of DBOF is to make more support services reimbursable. Hence, the more recent data should show more costs in the ED and EF accounts and fewer costs in the EC accounts. However, the EC accounts were still used quite extensively in FY90. Therefore, we must assess the estimates that hospitals made of the value of support services received from their host bases.

a. Comparison Among the Three Services

Officials in the Naval Bureau of Medicine and Surgery (BuMed) indicated that Navy hospitals pay essentially all of their own base operations and RPMA. Similarly, officials in the Air Force Office of the Surgeon General indicated that they pay essentially all costs within a 50-foot radius of the hospital. By contrast, most base operations and RPMA were *not* considered reimbursable by Army hospitals during FY90. For the Army, therefore, the majority of these costs should appear as estimates in the EC accounts of MEPRS.

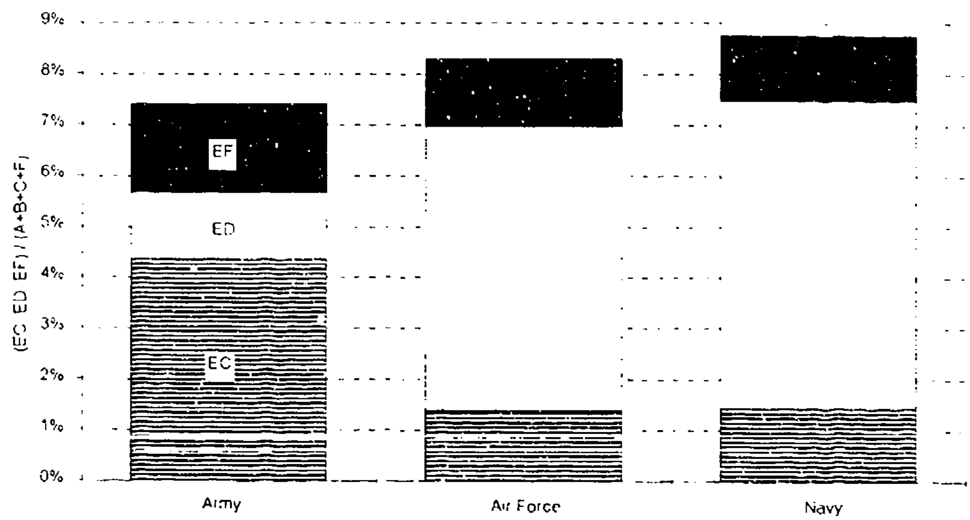
There is a *prima facie* case that reporting of base operations and RPMA is more accurate and comprehensive for the Navy and the Air Force than for the Army. The Navy and Air Force report funds actually transferred, whereas the Army relies on estimates of the value of support services received. Figure II-1 provides some evidence on this hypothesis. The figure displays support-service costs as a fraction of total "direct" MEPRS costs. More specifically, the numerator is the sum of MEPRS expenses in accounts EC, ED and EF, world-wide for all MTFs in FY90. The denominator is the sum of MEPRS expenses in accounts A (Inpatient), B (Ambulatory), C (Dental), and F (Special Programs). The latter are the broad clinical accounts that are supported by reimbursable and non-reimbursable expenses.

As expected, the Navy and the Air Force show much larger proportions of reimbursable (ED) than non-reimbursable (EC) expenses. In addition, the ratio of support to direct costs is nearly equal for these two Services, perhaps indicating that both are reporting costs comprehensively.

Also as expected, the Army shows a much larger proportion of non-reimbursable support expenses (EC). The surprising feature is the magnitude of the EC account, about 4.3% of total direct costs. In combination, the EC, ED and EF accounts for the Army sum to 7.4% of total direct costs, a figure nearly comparable to that observed for the Navy and

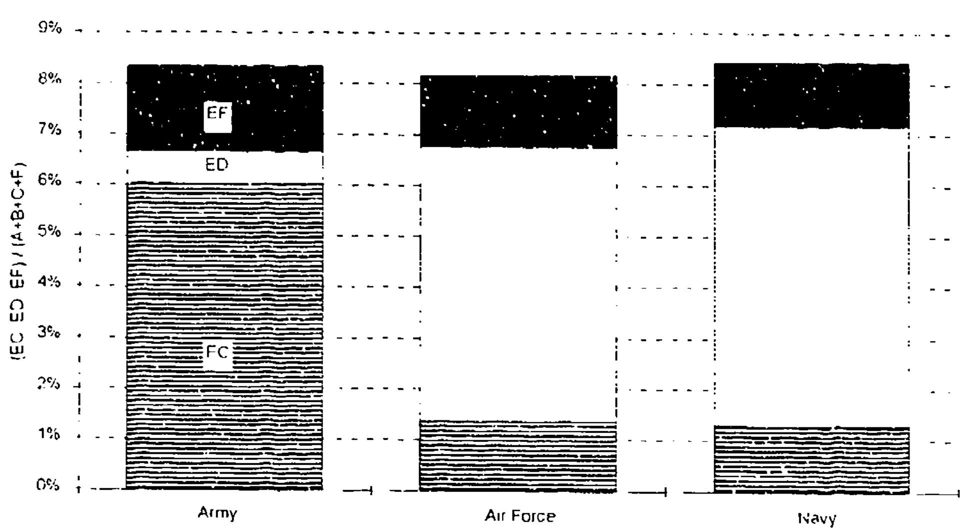
the Air Force. If we accept the latter two Services as a benchmark, then the Army estimates may be reasonable.

Further evidence is provided by Figure II-2, which presents an average over the four-year period, FY87-FY90. The ratios for the three Services are nearly identical when viewed over this longer time horizon. We conclude that the Army support-cost ratios require no adjustment relative to the Navy and the Air Force.



Note: EC=non-reimbursable expenses, ED=reimbursable expenses, and EF=directly-funded expenses.

Figure II-1. Support Accounts as a Percentage of Direct Accounts: MEPRS, FY90



Note. EC=non-reimbursable expenses, ED=reimbursable expenses, and EF=directly-funded expenses

Figure II-2. Support Accounts as a Percentage of Direct Accounts: MEPRS, FY87-FY90

b. Comparison Between MEPRS and the FYDP

A different perspective is obtained by comparing MEPRS data not among the Services, but rather to the corresponding Program Elements (PEs) in the FYDP. Real property maintenance for military hospitals is funded in PE 0807794, and base operations are funded in PE 0807796.[3] The Army FYDP data are of limited use in this comparison, because PE 0807796 funded only three sites during FY90: Walter Reed AMC, Fitzsimons AMC, and Ft. Detrick.[4]

The Air Force data are of much greater interest in this regard, because Air Force Regulation 170-5 (15 May 1992) provides a cross-walk between MEPRS clinical accounts and the PEs from which they are funded. For example, each three-digit MEPRS code beginning with A (Inpatient), B (Ambulatory), or D (Ancillary) maps into two admissible PEs: 0807711 (Care in Regional Defense Facilities) and 0807792 (Station Hospitals and Medical Clinics). Similarly, each three-digit MEPRS code beginning with C (Dental) maps into PE 0807715 (Dental Care Activities).

The regulation also indicates the three-digit MEPRS accounts that map into the PE 0807794. If all the obligated funds are faithfully reported in MEPRS, then the MEPRS subtotal in these accounts should equal the FYDP obligation in PE 0807794. Table II-2 indicates that the MEPRS subtotal and the FYDP obligation were remarkably close in FY90, differing by about $2 million or less than two percent. Therefore, the Air Force support-cost ratio, shown previously in Figures II-1 and II-2, indeed appears to be an adequate benchmark for the other two Services. In light of the similarity in support-cost ratios across the three Services, we concluded that MEPRS requires no adjustment for base operations or RPMA.

2. Management Headquarters

For comparability with prices charged in the civilian sector, the cost of military medicine should include a component for management headquarters. This component includes the three Service Surgeons General and their immediate headquarters staff. A comparable cost in the civilian sector might be, for example, the regional headquarters for

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[3] An exception is that the Air Force does not use PE 0807796; instead, both base operations and RPMA are combined into the single PE 0807794.

[4] Ft. Detrick, Maryland, is not an MTF, but is a stand-alone facility providing automation support and other services to the DoD medical community.

Kaiser Permanente. This cost would be passed along to customers in the prices charged by civilian-sector providers.

Table II-2. Comparison of Air Force Support Accounts, FY90

MEPRS Code	Account title	MEPRS Expenses	FYDP Operations and Maintenance (O&M) Obligations (PE 0807794)
EDB	Funded Operation of Utilities	$37,324,181	
EDC	Funded Maintenance of Real Property	$39,950,243	
EDD	Funded Minor Construction	$14,112,953	
EDE	Funded Other Engineering Support	$8,534,615	
EDF	Funded Lease of Real Property	$395,866	
EFA	In-house Housekeeping	$760,089	
EFB	Contract Housekeeping	$30,562,408	
Subtotal		$131,640,355	$129,410,000

Costs for management headquarters are not reported in MEPRS, but an estimate may be made from FYDP data. Program element 0807798 contains FYDP obligations for Management Headquarters, Medical. This PE showed $21.7 million each for the Army and the Navy in FY90. The Air Force did not report any obligations in this PE in FY90. Although the management-headquarters function is certainly present in the Air Force, it is not visible in the FYDP.

We have charged the Air Force $21.7 million for management headquarters, precisely the amount reported by the other two Services in the FY90 FYDP. The MEPRS totals for that year are displayed in Figure II-3, by Service and one-digit MEPRS account. The Army had the highest MEPRS total, followed by the Air Force and then the Navy. The headquarters allocation of $21.7 million amounts to 0.68% of the Army MEPRS total of $3.173 billion, and 1.11% of the Navy MEPRS total of $1.948 billion. The Air Force is bracketed between the other two Services, with the headquarters allocation representing 0.85% of its MEPRS total of $2.548 billion.

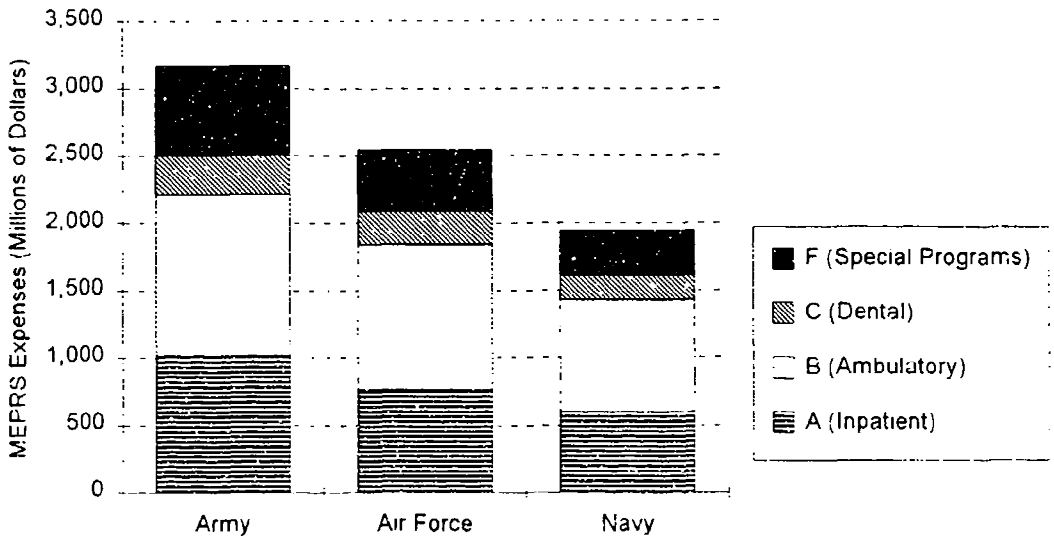

Figure II-3. FY90 MEPRS Expenses, by Service and Functional Category

3. Facilities Construction Allowance

Civilian-sector medical prices include an amortization for facilities construction. However, there is no corresponding cost element in MEPRS.[5] The purpose of this section is to develop a facilities construction allowance, again with the goal of making costs comparable between the military and civilian sectors. The remainder of this section describes three approaches to developing a facilities construction allowance. Based on these three approaches, our best estimate of the construction allowance is 4.3% of MEPRS operating expense.

a. Economic Analyses of Hypothetical Military Hospitals

First, economic analyses were examined for the construction of 14 hypothetical military hospitals. Multiple scenarios were available for some of the hospitals, yielding a total of 37 construction scenarios. Under each scenario, the hospital was designed to serve a specified annual workload. Engineering estimates were then made of both initial construction costs and recurring operating costs corresponding to each hypothetical

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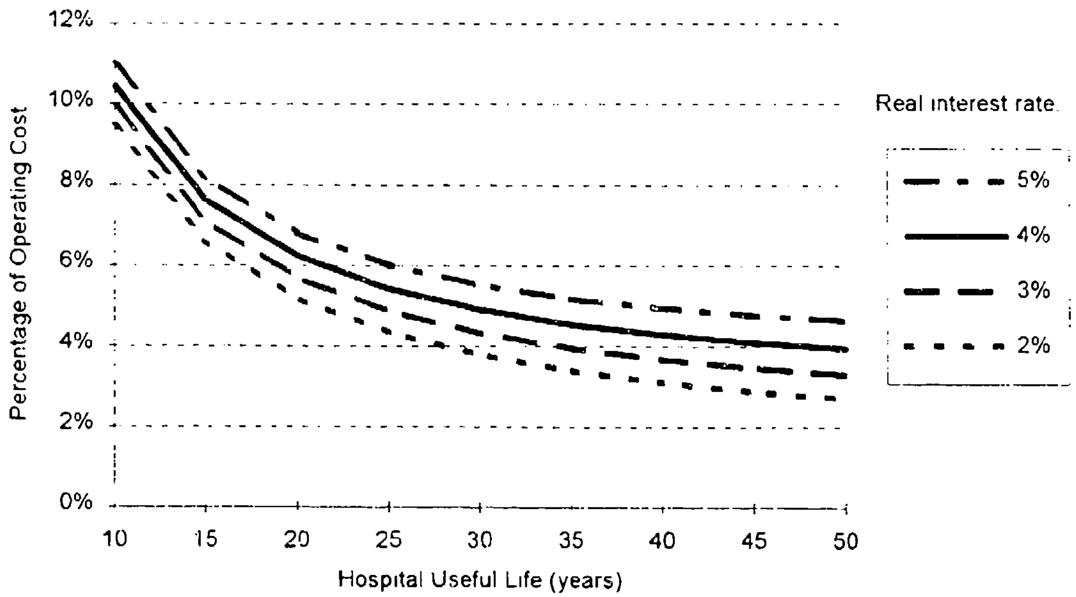
5 The EA account of MEPRS contains a depreciation allowance for modernization and replacement equipment. However, MEPRS does not contain any estimate of depreciation associated with: (1) new and expanded facilities, (2) real property installed equipment (such as environmental control units and elevators), or (3) war readiness material. See "Medical Expense and Performance Reporting System for Fixed Military Medical and Dental Treatment Facilities," p. 2E-4.

workload. Construction costs include the following elements: new building construction, initial medical equipment, supporting facilities, contingencies, plus allowances for supervision, inspection and overhead. The engineering estimates of operating cost correspond roughly to the total of the A (Inpatient), B (Ambulatory), C (Dental) and F (Special Programs) accounts of MEPRS In particular, the C and F accounts were included in the cost basis because construction costs support all of these activities, not just inpatient and ambulatory care. Among the operating cost elements included are: physician salaries, supporting staff salaries, supplies, ancillary procedures, and support (e.g., base operations, RPMA, and housekeeping).

It would be unreasonable to charge the entire construction cost against a single year's operating budget. Instead, the construction cost was amortized over the notional lifetime of the facility. Ranges were considered for both the real interest rate and the notional facility lifetime. The relationship between amortized construction costs and annual operating costs was found to be the same for both community hospitals and medical centers. This relationship is depicted in Figure II-4.



Note. Operating cost corresponds to MEPRS A (Inpatient), B (Ambulatory), C (Dental), and F (Special Programs) accounts

Figure II-4. Amortized Construction Cost as a Percentage of Annual Operating Cost (at Various Real Interest Rates)

For long lifetimes, the four curves are essentially proportional to the real interest rate. Although a range of interest rates was considered, the preferred estimate uses a real annual rate of 4.0%, roughly the historical average yield on 30-year government bonds. The amortization curves flatten out beyond a useful life of about 35 years. Medicare's capital-cost reimbursement system uses an estimated 40-year lifetime, and we view this estimate as appropriate for military hospitals as well. The combination of a 40-year lifetime and a 4.0% real interest rate yields a construction-cost adjustment equal to 4.3% of MEPRS operating expense.

b. Comparison of Hospital Size and Historical Operating Costs

The second approach uses actual FY90 MEPRS operating costs, as opposed to engineering estimates based on hypothetical annual workloads. Similarly, the construction-cost estimates are obtained by multiplying actual square footage of 87 CONUS hospitals and 17 medical centers, by official DoD estimates of construction cost per square foot.[6]

The construction-cost estimates were amortized over a 40-year lifetime at a 4.0% real interest rate. The ratio of amortized construction costs to MEPRS operating costs provides an alternative estimate of the construction-cost adjustment factor. This procedure yielded an estimate of 4.1 percent. It is encouraging that this estimate, computed using entirely different data sources, is so close to the previous estimate of 4.3 percent.

c. Analysis of FYDP Military Construction Appropriations

Finally, a construction-cost adjustment factor may be estimated by analyzing military-construction appropriations in the FYDP. Of course, construction appropriations for a single fiscal year do not correspond to operating expenses for that same year. Instead, the existing inventory consists of facilities that were built in many previous years. In principle, the construction cost of each individual facility could be separately identified in the historical data, then adjusted to constant dollars after correcting for inflation, depreciation, obsolescence, major maintenance and renovation, and so on.

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[6] The construction cost estimates are contained in: "Area Cost Factors and Unit Prices for FY 1994-1995 Department of Defense Facilities Construction," Tri-Service Committee on Cost Engineering, Office of the Assistant Secretary of Defense (Production and Logistics), July 1992. In addition to facilities construction (i.e., brick and mortar), these estimates include an allowance for initial equipment to be used in both in-patient and ambulatory care.

Because the requisite historical data are difficult to obtain, we pursued a much less ambitious and more approximate approach. We obtained data on FY89 through FY92 construction projects from the Defense Medical Facilities Office (DMFO). That office divides construction projects into four categories: (1) minor construction, projects smaller than $300,000; (2) unspecified minor construction (UMC), projects between $300,000 and $1.5 million; (3) major construction, projects larger than $1.5 million, which are line-item authorized; and (4) planning and design (P&D), which is not separately identified by Service.[7] At our request, DMFO also divided construction projects into those relating to peacetime health-care, and those relating to wartime-contingency facilities. Table II-3 summarizes the DMFO data on categories (2) through (4).[8]

Table II-3. DMFO Major Construction and P&D/UMC Projects (Millions of Then-Year Dollars)

	Army		Air Force		Navy		
Fiscal Year	Peacetime	Total	Peacetime	Total	Peacetime	Total	P&D/UMC
1989	143.7	143.7	92.7	107.9	33.4	52.9	30.6
1990	102.0	103.5	29.2	29.2	56.7	74.7	45.7
1991	77.2	77.2	61.7	61.7	63.0	69.5	47.0
1992	64.6	64.6	30.5	33.5	119.6	141.6	46.2
Four-Year Average:	96.9		53.5		68.2		

Note: P&D = planning and design, UMC = unspecified minor construction.

The military-construction appropriations show wide year-to-year variations. As a crude attempt to smooth the data, we computed the four-year average of the peacetime-related projects. The Army average of $96.9 million amounts to 3.1% of the Army MEPRS total of $3.173 billion in FY90. The Air Force average of $53.5 million amounts

7 There is a separate Program Element for P&D, 0807716D (Medical Facilities, Planning and Design). The other categories of construction are funded through Program Element 0807717D (Medical Facilities, Military Construction). In each case, the "D" suffix indicates that these are OSD, rather than Service, Program Elements.

8 Regarding category (1), the Services control minor construction (projects smaller than $300,000). The FYDP showed $30.4 million of minor construction for the Navy in FY90, and $15.4 million for the Army. The BuMed staff provided a breakout of the $30.4 million, which funded construction of bachelor enlisted quarters (BEQs) and parking structures associated with Navy hospitals. We deemed these expenditures unrelated to the peacetime-care mission, and thereby excluded them from the analysis. Although we did not have access to a breakout of the Army's $15.4 million, we excluded these expenditures as well. Thus, minor construction had no effect on our final estimates.

to 2.1% of the Air Force MEPRS total of $2.548 billion. Finally, the Navy average of $68.2 million represents 3.5% of the Navy MEPRS total of $1.948 billion

These factors are smaller than those computed by the first two methods. We consider this last method to be the least reliable of the three, because the volatile military-construction appropriations for FY89 through FY92 need not reflect the replacement costs for facilities already in place during that time period. We believe our best estimate of the construction allowance is 4.3% of MEPRS operating expense, based on the first method discussed.

4. Central Automation Support

The Defense Medical Systems Support Center (DMSSC) provides central automation support to the entire DoD medical community, including CHAMPUS as well as military hospitals. An adjustment to MEPRS is required, because the corresponding cost would be passed along to customers in the prices charged by civilian-sector providers. However, we must be careful to pass along only a portion of the DMSSC cost to MEPRS; the remainder is implicitly passed along to CHAMPUS, which is also supported by DMSSC.

Figure II-5 displays the DMSSC appropriations, in detail for FY90 and in total for FY91 and FY92. DMSSC is funded through Program Element 0807791D, and the total appropriation has remained relatively stable over the period FY90 to FY92.

We have spread the FY90 DMSSC total appropriation across the three Services in proportion to the sum of each Service's CHAMPUS expenses plus its total MEPRS expenses in accounts A, B, C and F. This procedure is illustrated in Table II-4. The DoD total in MEPRS plus CHAMPUS[9] was $10.3 billion in FY90. The $133 million DMSSC total represents 1.29% of the DoD total. Therefore, we impose a charge of 1.29 cents on each dollar of MEPRS expense, as well as a similar charge on each dollar of CHAMPUS expense. In effect, this procedure allocates $40.9 million to Army MEPRS cost, $32.8 million to Air Force MEPRS cost, and $25.1 to Navy MEPRS cost. The presumption is that the Army, having the largest MEPRS cost, derives the most benefit from DMSSC.

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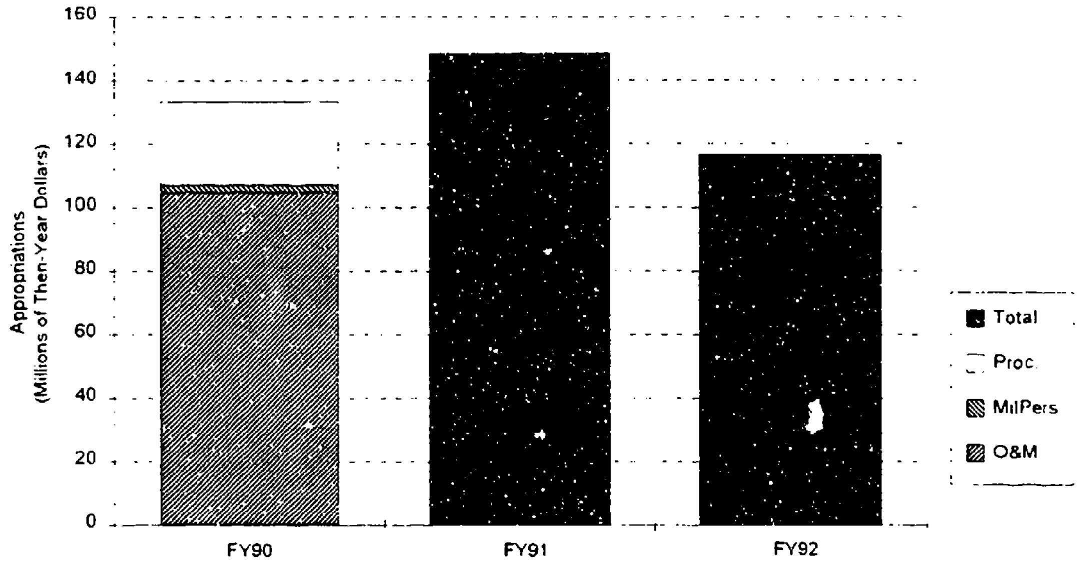
9 The source for the CHAMPUS data is "CHAMPUS Chartbook of Statistics," Office of the Civilian Health and Medical Program of the Uniformed Services, Publication 5400.2-CB, October 1992, p. IV-7. We used the government cost, excluding European claims but including both the CHAMPUS Reform Initiative and the CHAMPUS mental health demonstration (Norfolk, Virginia).



Note: O&M=Operations and Maintenance, MilPers=Military Personnel, and Proc.=Procurement.

Figure II-5. DMSSC Appropriations

Table II-4. Allocation of FY90 DMSSC Appropriation (Millions of Dollars)

	Army	Air Force	Navy	DoD total
MEPRS Account.				
A (Inpatient)	1,016	763	597	2,377
B (Ambulatory)	1,198	1,077	827	3,102
C (Dental)	292	250	185	727
F (Special Programs)	666	458	338	1,462
MEPRS Total:	3,173	2,548	1,948	7,669
CHAMPUS	904	756	1,001	2,661
Service Total:	4,076	3,304	2,949	10,329
DMSSC Allocation to MEPRS	40.9	32.8	25.1	98.7
DMSSC Allocation to CHAMPUS	11.6	9.7	12.9	34.3
Total DMSSC Allocation:	52.5	42.5	38.0	133.0

5. Military Personnel Pay Factors

MEPRS imputes military-personnel compensation as the product of full-time equivalents (FTEs) recorded at the MTF and a set of annual pay factors. The MEPRS pay factors are dimensioned by fiscal year, Service, and either officer rank or enlisted paygrade. However, no account is taken of occupational specialty, or of the associated specialty pays and bonuses. Therefore, MEPRS imputes the same salary to an O-4 Medical Service Corps (MSC) officer as to an O-4 thoracic surgeon. The purpose of this section is to determine whether the neglect of occupational specialty pay leads to an understatement of MEPRS expenses.

The MEPRS pay factors were surprisingly difficult for us to obtain, but are generally presumed to be equal to the composite standard military rates used by the Service comptrollers for inter-Service exchange; the latter are much easier to obtain.[10] We were able to obtain the MEPRS pay factors in one case, the Air Force in FY91. Looking across all the officer ranks and enlisted paygrades, the MEPRS pay factors differed from the Service-comptroller rates by at most 1.65 percent. IDA has attempted to improve on the MEPRS and Service-comptroller pay factors. We did this by first adopting, with minor modifications, some pay factors estimated explicitly for medical personnel by OASD (Health Affairs). We then calculated the difference in total MEPRS expense when the new pay factors are substituted for the MEPRS pay factors.

We began with a set of FY91 medical-personnel pay factors computed by OASD (Health Affairs). These factors are based on tabulations from the Joint Uniformed Military Payroll System (JUMPS) files.[11] The OASD (Health Affairs) factors are available in the following personnel categories: physician, dentist, optometrist, veterinarian, nurse, MSC officer, and medical enlisted. Unfortunately, these is no further detail by physician specialty. The most important element of these factors is the medical special pay, which, in the case of physicians, is computed as a weighted average over all physician specialties. We adjusted these factors by adding one omitted component, the employer contribution to Social Security, and deleting a few other components that are accounted for elsewhere in our analysis.

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[10] For example, the FY91 rates for all four Services are contained in "Composite Standard Military Rates, Basic Allowance for Quarters Rates, and Permanent Change of Station Expense Rates, Effective 1 October 1990," Comptroller of the Navy, NavComptNote 7041, October 1990.

[11] Further documentation is available from Commander D. Sevier, OASD (Health Affairs).

An example of the IDA pay factors is found in Table II-5. For an Air Force major (rank O-4) during FY91, the comptroller pay factor was $79,746, and the MEPRS pay factor was $80,420. These two factors differ by only 0.85 percent. As shown in the table, the IDA pay factor for an Air Force O-4 *physician* is $105,314. These pay factors differ primarily because the IDA factor includes medical special pay of $38,071. This quantity replaces a much smaller, average special pay for all Air Force majors (not necessarily physicians) that is implicit in the comptroller and MEPRS pay factors.

Table II-5. IDA Pay Factor: Air Force Physician, Rank O-4 (Major), FY91

Pay Element	Pay
Base Pay	$36,868
Allowances	$11,130
Medical Special Pays	$38,071
Other Pays	$365
Retirement Accrual	$15,743
Employer Social Security Contribution	$3,137
Total:	$105,314

Table II-6 is an attempt to assess, in the aggregate, the effect of substituting the IDA pay factors for the MEPRS pay factors. We report the average (across ranks[12] and paygrades) of the IDA pay factors and the MEPRS pay factors, for the Air Force in FY91. The averages were computed by weighting across rank/paygrade distributions provided by the Defense Manpower Data Center (DMDC). We multiplied the pay differences by the number of FTEs in each category, as reported in MEPRS, to obtain the pay adjustment (in millions of dollars).

Although MEPRS understates average physician compensation by over $17,000, it *overstates* the compensation of nurses, MSC officers, and medical enlisted personnel. In light of the relatively large number of medical enlisted personnel, the net effect is actually a *downward* adjustment to MEPRS of $11.1 million. However, this adjustment represents a mere 0.60% of the Air Force MEPRS inpatient and ambulatory subtotal. Because this adjustment is so small, and because the exact MEPRS pay factors were not readily

12 The average physician salaries are slightly below the O-4 figures cited previously in the text. Military physicians begin their careers at rank O-3, and this is actually the modal rank. For the Air Force, the *average* physician rank (excluding general officers) is 3.9.

available for other combinations of Service branch and fiscal year, we have ignored the adjustment in our subsequent calculations.

Table II-6. Adjustment for MEPRS Military-Personnel Pay Factors, Air Force, FY91

Personnel Category	IDA Pay Factor	MEPRS Pay Factor	IDA Factor Minus MEPRS Factor	Full-Time Equivalents (FTEs)	Pay Adjustment (Millions of FY91 Dollars)
Physicians	$95,236	$78,091	$17,144	2,968	50.9
Nurses	$59,703	$64,738	-$5,035	3,625	-18.3
Medical Service Corps	$64,975	$68,428	-$3,453	2,381	-8.2
Medical Enlisted	$27,815	$29,877	-$2,061	17,213	-35.5
Total Adjustment					-11.1
MEPRS Subtotal					1,840
Percent Adjustment					-0.60%

While the MEPRS pay factors impart no bias in the aggregate, they do give a misleading picture of the *relative* costs of various categories of personnel. For other purposes, such as determining the optimal mix of physicians, nurses, and medical enlisted personnel, it would be better to use the adjusted pay factors reported here. Otherwise, the standard pay factors may lead to a mix that is too rich in physicians relative to the other categories of personnel.

6. Allocation of MEPRS Special-Programs Accounts

The MEPRS F (Special Programs) accounts were originally designed to measure costs incurred at MTFs in support of DoD's wartime readiness mission. Over the years, as additional three-digit accounts were added, some costs related instead to the peacetime health-care mission have migrated to the F accounts. The purpose of this section is to fold back to the A (Inpatient) and B (Ambulatory) accounts those specific three-digit F accounts that are demonstrably and exclusively related to the peacetime-care mission.

The F accounts that we have selected are analyzed in Table II-7. The Area Reference Laboratories provide clinical laboratory and forensic toxicology procedures and tests to other MTFs. Of the ten laboratories, nine are operated by the Army, and the remaining one is operated by the Navy at NNMC Bethesda. However, the Navy did not

Table II-7. Allocation of MEPRS Special-Programs Accounts, FY90

Account Code	Account Title	Army	Air Force	Navy	DoD Total
FAA	Area Reference Laboratories				21,227,080
	Allocation of FAA, by Service	8,579,128	7,128,386	5,519,567	21,227,080
FAH	Clinical Investigation Program	15,710,656	13,046,012	3,118,337	31,875,005
FAK	Student Expenses	103,386,956	40,321,354	39,395,058	183,103,368
FAL	Continuing Health Education	25,842,780	16,443,939	16,136,399	58,423,118
	Subtotal	153,519,520	76,939,691	64,169,361	294,628,571
FEA	Patient Transportation	37,165,712	7,002,563	11,022,300	55,190,575
FEB	Patient Movement Expenses	848,523	9,611,576	1,683,270	12,143,369
FEC	Transient Patient Care	14,980	11,283	55,119	81,382
	Subtotal	38,029,215	16,625,422	12,760,689	67,415,326
	Total	191,548,735	93,565,113	76,930,050	362,043,897
A	Total inpatient expenses	1,016,201,564	763,289,016	597,216,755	2,376,707,335
	Allocation excluding FEA and FEB	70,453,035	31,918,880	26,900,111	
	Percentage adjustment	6.93%	4.18%	4.50%	
	Allocation of FEA and FEB	38,029,215	16,625,422	12,760,689	
	Percentage adjustment	3.74%	2.18%	2.14%	
	Total inpatient adjustment	10.68%	6.36%	6.64%	
B	Total ambulatory expenses	1,198,135,627	1,076,600,769	827,424,836	3,102,161,232
	Allocation excluding FEA and FEB	83,066,484	45,020,811	37,269,249	
	Total ambulatory adjustment	6.93%	4.18%	4.50%	

report any expenses in MEPRS account FAA (Area Reference Laboratories) in either FY90 or FY92. The Army total of $21.2 million supported not just Army MTFs, but actually all MTFs. Therefore, we allocated this sum across the Services in proportion to their total MEPRS inpatient and ambulatory expenses. This allocation amounts to 0.39% of the MEPRS A and B accounts. In absolute terms, the allocations are $8.6 million for the Army, $7.1 million for the Air Force, and $5.5 million for the Navy. To the extent that the Army laboratories disproportionally support Army MTFs, as is often asserted, these allocations will bias the costs low for the Army and high for the other two Services.

We allocated accounts FAH (Clinical Investigation Program), FAK (Student Expenses), and FAL (Continuing Health Education) directly to each Service. The FAH account records expenses intended to: "advance the quality of healthcare rendered in military medical facilities, as measured by presently accepted professional standards, including statistical health data [and] accreditation evaluation.[13]" The FAK account reports student salary expenses in the following categories: continuing post-graduate education for physicians, dentists, veterinarians, and nurses; and continuing training for medical specialists, allied health-science personnel, administrators, other enlisted direct-care paraprofessionals, and assigned non-medical personnel.[14] Specifically, the FAK account reports: "student salary expenses [for] time the student is in a pure learner role (classroom, work-center learning, etc.)....Salary expenses related to that time a student directly contributes to work-center output may be charged to the work center.[15]" Physicians charge all of their time to FAK during their first year of post-graduate training, and a nominal 50% of their time during their second and subsequent years of training. Finally, the FAL account records: "operating expenses required to support continuing education...[including] tuition, TAD [temporary additional duty] and/or TDY [temporary duty] expenses, salaries, fees, and contractual expenses."[16]

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[13] See "Medical Expense and Performance Reporting System for Fixed Military Medical and Dental Treatment Facilities," p. 2F-8.

[14] Ibid., pp. 2E-10 to 2E-11. Note that expenses other than student salaries (e.g., instructor salaries, medical library, medical illustration, and medical photography) are reported in MEPRS accounts EBE (Graduate Medical Education Support) and EBF (Education and Training Program Support). These intermediate operating accounts are stepped-down to the final operating accounts (i.e., Inpatient, Ambulatory, or Dental) based on FTEs as recorded in personnel timesheets. Thus, they are already reflected in MEPRS, and need not be treated as additional adjustments.

[15] Ibid., p. 2F-9.

[16] Ibid., p. 2F-9.

We allocated these accounts across each Service's total MEPRS inpatient and ambulatory expenses. For example, of the Army subtotal of $153.5 million in accounts FAA, FAH, FAK, and FAL, we allocated $70.4 million to inpatient expenses and $83.1 million to ambulatory expenses. Thus, we increased the MEPRS A and B accounts by a factor of 6.93% each. Similarly, we increased these accounts by 4.18% in the Air Force and 4.50% in the Navy.

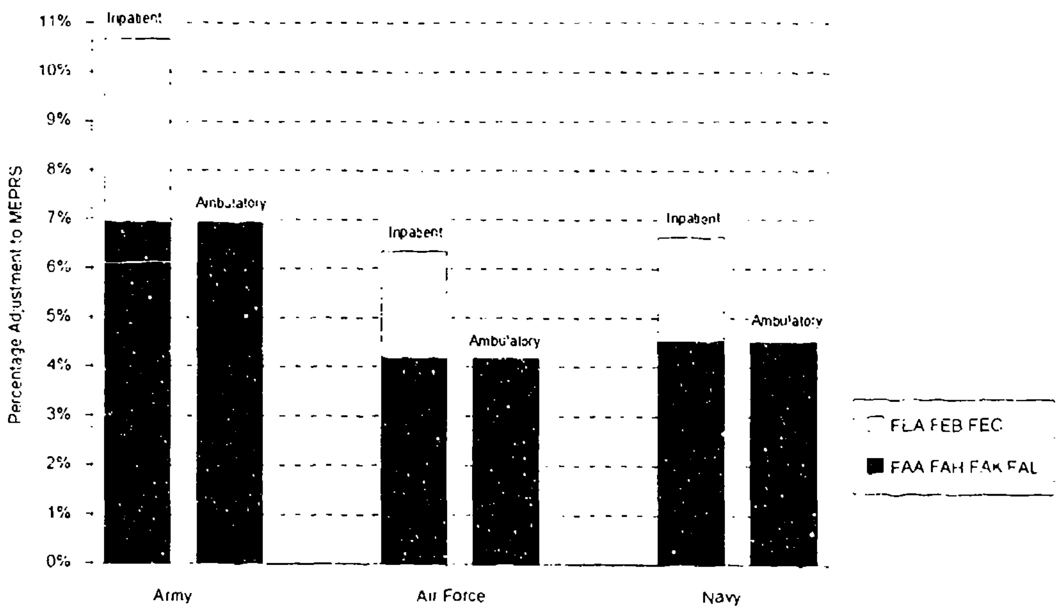
Expenses in the FAK account are accrued primarily in medical centers and the few community hospitals that offer Graduate Medical Education (GME), although some expenses may be accrued at smaller facilities that train enlisted medical specialists and paraprofessionals. Had we allocated these costs directly (and exclusively) to the medical centers and teaching hospitals, these facilities would have appeared more expensive than the remaining hospitals. We felt it inappropriate to burden the medical centers and teaching hospitals with the entire FAK total. Instead, GME supports the flow of new physicians to replenish *all* of the hospitals in the system. For this reason, we treated the FAK account as system-wide overhead.

Along these lines, we considered including adjustments for PE 0806721 (Uniformed Services University of the Health Sciences) and PE 0806722 (Armed Forces Scholarship Program). Ultimately, we decided to treat these two activities as "below-the-line," and we did not include them in the MEPRS adjustments. These activities do not represent patient care provided in MTFs; in particular, the Armed Forces Scholarship Program funds medical education provided by civilian institutions. Rather than incorporating these activities into MEPRS, they should be added back to the sum of the IDA and RAND cost estimates for any analytical cases under consideration. An example of this approach is given in Chapter IV. If these activities are expected to change under the analytical cases, then that calculation should be conducted independently of either the IDA or RAND cost analyses.

We also considered MEPRS accounts FEA (Patient Transportation), FEB (Patient Movement Expenses), and FEC (Transient Patient Care). Account FEA covers expenses to: "operate and maintain emergency medical vehicles and ambulances...for the movement of non-emergency inpatients and out-patients to, from, and between MTFs...[and for] patients who require immediate care on an unscheduled basis enroute to an MTF." Account FEB records expenses to: "move inpatients, out-patients, and attendants between medical facilities to provide optimum care." Account FEC covers expenses to: "provide

care to transient patients [at] facilities located on air routes used by the aeromedical evacuation system.[17]" These three accounts pertain to transportation assets, such as buses and ambulances, that are owned by the medical community, *not* airlift assets owned by operational units in Major Force Program 2 (General Purpose Forces). Although the MEPRS manual mentions out-patients as well as inpatients, our experience reveals that most of these expenses are related to inpatients. Therefore, we have allocated accounts FEA, FEB, and FEC to the MEPRS A account only. This allocation amounts to 3.74% for the Army, 2.18% for the Air Force, and 2.14% for the Navy.

The total F account adjustments are illustrated in Figure II-6. The total inpatient adjustments are 10.68% for the Army, 6.36% for the Air Force, and 6.64% for the Navy. The adjustment is largest for the Army, primarily because they operate the largest GME program, as reflected by the total of $103 million in their FAK (Student Expenses) account in FY90.



Notes: FAA=Area Reference Laboratories, FAH=Clinical Investigation Program, FAK=Student Expenses, FAL=Continuing Health Education, FEA=Patient Transportation, FEB=Patient Movement Expenses, and FEC=Transient Patient Care.

Figure II-6. Percentage Adjustments Based on MEPRS F Accounts

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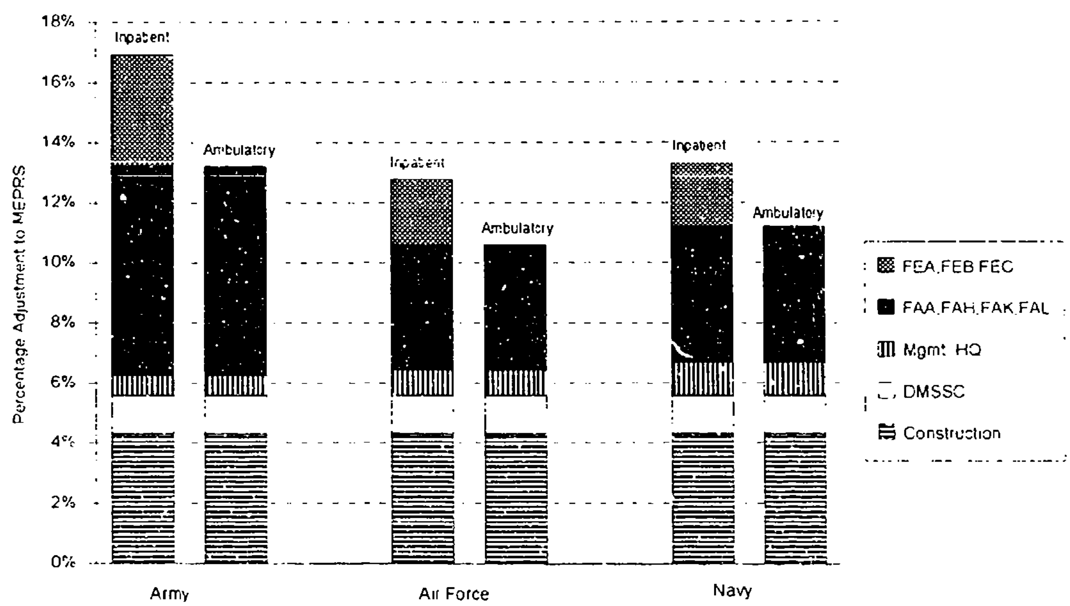
[17] See "Medical Expense and Performance Reporting System for Fixed Military Medical and Dental Treatment Facilities," p. 2F-20.

7. Summary

Figure II-7 summarizes our adjustments to the FY90 MEPRS expenses. Recall that our analyses of base operations and military-personnel pay factors did not lead to any net adjustments. We developed a 4.3% facilities-construction allowance, based upon amortizing construction costs over a 40-year lifetime at a 4.0% real interest rate. Our factor of 1.29% for DMSSC was derived by spreading the DMSSC appropriation across the three Services, in proportion to their total MEPRS expenses. The adjustment for management headquarters was based on an expenditure of $21.7 million per Service. Finally, the adjustments based on MEPRS F accounts were given in Figure II-6, with larger adjustments for inpatient care to reflect patient transportation and movement expenses.



Notes: FAA=Area Reference Laboratories, FAH=Clinical Investigation Program, FAK=Student Expenses, FAL=Continuing Health Education, FEA=Patient Transportation, FEB=Patient Movement Expenses, FEC=Transient Patient Care, and DMSSC=Defense Medical Systems Support Center.

Figure II-7. Summary of Adjustments to FY90 MEPRS Expenses

The total adjustments are approximately equal for the Air Force and the Navy: 12.8% for Air Force inpatient expenses, 13.3% for Navy inpatient expenses, 10.6% for Air Force ambulatory expenses, and 11.2% for Navy ambulatory expenses. The adjustments are larger for the Army: 16.9% for inpatient expenses, and 13.2% for ambulatory

expenses. The larger Army adjustments result from larger totals in the F accounts, as shown previously in Table II-7, the Army subtotal in accounts FAA, FAH, FAK, FAL, FEA, FEB, and FEC is twice as large as either the Air Force or the Navy subtotal. By far the largest factor in this difference is the FAK (Student Expenses) account, reflecting the fact that the Army operates the largest GME program among the Services.

C. ASSESSMENT OF ADJUSTED MEPRS EXPENSES

The MEPRS adjustments may be assessed by examining their impact on aggregate MEPRS expenses. Table II-8 shows the reported FY92 MEPRS expenses, by inpatient versus ambulatory care, Service branch, and hospital size. Reported inpatient expenses were $2.41 billion for inpatient care, and $3.20 billion for ambulatory care. The corresponding adjusted figures are $2.76 billion for inpatient care, and $3.56 billion for ambulatory care. The aggregate percentage adjustments are 14.3% and 11.3%, respectively. Having made these adjustments, we are much more confident about making a fair comparison to medical costs in the civilian sector.

Table II-8. Comparison of Reported and Adjusted FY92 MEPRS Expenses (Millions of FY92 Dollars)

		MEPRS FY92 Reported	MEPRS FY92 Adjusted
Inpatient			
Army	Medical Center	638.4	799.9
	Hospital	393.7	457.5
Air Force	Medical Center	383.7	432.5
	Hospital	335.7	378.3
Navy	Medical Center	373.4	420.8
	Hospital	236.8	266.9
Inpatient Total		2,411.7	2,755.9
Ambulatory			
Army	Medical Center	527.9	593.9
	Hospital	696.6	783.7
	Clinic	19.0	21.4
Air Force	Medical Center	295.8	326.9
	Hospital	658.9	728.1
	Clinic	98.1	108.3
Navy	Medical Center	362.4	400.8
	Hospital	457.7	506.2
	Clinic	81.7	90.4
Ambulatory Total		3,198.1	3,559.6
Total Cost		5,609.8	6,315.5

D. ADDITIONAL DATA ELEMENTS

A few of the data elements required for the regression analysis derive from sources other than MEPRS. These data elements and their sources are described here.

1. Bed Capacity

The two candidate measures of bed capacity for inpatient care are normal beds and operating beds. Both measures are reported by the Services to DMFO. Normal bed capacity is defined as:

> Space for patients' beds measured in terms of beds, which can be set up in wards or rooms designated for patients' beds and spaced approximately 100 to 120 square feet per bed. *This definition refers only to space and excludes equipment and staff capability.* For containment-type hospitals still in use, bed capacity may be measured in beds spaced on 8-foot centers. Former ward or room space, which has been disposed of or has been altered so that it cannot be readily reconverted to ward or room space, is not included in computing bed capacities. Space for beds used only in connection with examination or brief treatment periods, such as that in examining rooms or in the physiotherapy department, is not included in this figure. Nursery space is not included in the bed capacity, but is accounted for separately in terms of the number of bassinets it accommodates. [Emphasis added.][18]

By contrast, an operating bed is defined as: "a bed that is currently set up and ready in all respects for the care of a patient. *It must include supporting space, equipment, and staff to operate under normal conditions.* Excluded are transient patients' beds, incubators, bassinets, labor beds, and recovery beds."[19] [Emphasis added.] Because operating beds are fully staffed, they appear to be the more appropriate capacity measure for hospitals in peacetime. Indeed, preliminary regression models using normal beds did not predict MTF costs as accurately as the later models using operating beds.

The data on normal and operating beds have not always been regularly updated. In our judgment, the FY90 data had not been updated recently enough to be of use in this study. The FY92 data, however, appear both more recent and more relevant. Therefore,

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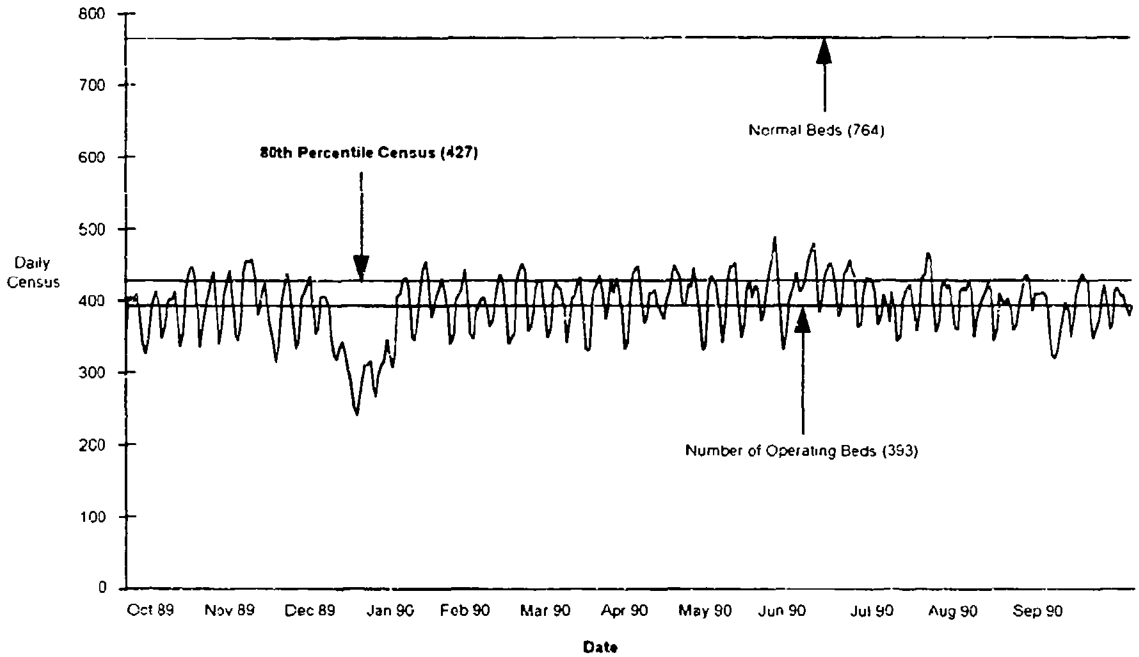
[18] See "Medical Expense and Performance Reporting System for Fixed Military Medical and Dental Treatment Facilities," p. A-18.

[19] Ibid., p. A-19.

we applied the FY92 numbers of normal and operating beds in our analyses of both FY90 and FY92 data on cost and workload.

The relationship between normal and operating beds is illustrated in Figure II-8. The jagged curve represents the trend in daily census at Naval Hospital San Diego during FY90. For reference, we note that the average daily census equals 392, and the 80th percentile of the daily census equals 427. Operating beds were reported as 393. This figure certainly lies within the range observed for the daily census. If operating beds represent staffed capacity, however, one might expect this value to exceed the mean and possibly exceed the 80th percentile as well. We suspect that operating beds are not updated frequently enough to reflect seasonal changes in staffing that occur within the fiscal year.



Note: Average daily census = 392.

Figure II-8. Naval Hospital San Diego, FY90 Daily Census

By contrast, normal beds were reported as 764. This figure bears no apparent relationship to the trend in daily census, and offers little indication of peacetime capacity. Similar patterns were observed at several other MTFs that we examined. We conclude

that FY92 reported operating beds, though imperfect, provide the best available proxy for peacetime capacity.

2. Graduate Medical Education

We measured the volume of GME by the headcount of residents and interns at each MTF. This information was provided by OASD (Health Affairs/Professional Affairs and Quality Assurance). This measure differs from the one used by the Health Care Financing Administration (HCFA) for Medicare reimbursement.[20] The HCFA measure is defined as the headcount of resident and interns, divided by the number of staffed beds at each hospital; the HCFA definition of staffed beds is roughly analogous to the DoD definition of operating beds. The HCFA measure is relevant for inpatient care only, with staffed beds serving as a capacity variable. There is no obvious capacity variable for ambulatory care. In our data on MTFs, we found evidence that GME affects the cost of ambulatory care as well as inpatient care. The advantage of our GME measure (i.e., the simple headcount) is that it does not require a capacity variable; thus, it is well-defined even on the ambulatory side.

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[20] Health Care Financing Administration, "Federal Register," Vol. 52, No. 169, September 1, 1987.

III. DEVELOPMENT OF MEDICAL TREATMENT FACILITY COST FUNCTIONS

This chapter discusses the Military Treatment Facility (MTF) cost functions used to project the total cost of providing care at DoD hospitals under several analytical cases. These cases will be described further in Chapter IV. The cost functions estimate the total costs of operating each individual facility, given projections of inpatient and ambulatory workload at each facility, the capacity of each facility measured in terms of operating beds, and the number of residents and interns enrolled in each facility's Graduate Medical Education (GME) program (where applicable). The facility-level costs are then summed over all facilities to estimate the system-wide costs of providing care at DoD hospitals under each analytical case. The costs of providing care within the civilian sector, and paid through the Civilian Health and Medical Program of the Uniformed Services (CHAMPUS), are being separately estimated by the RAND Corporation.

To develop the cost functions, econometric modeling was applied to identify independent variables that explain the variation in cost across DoD hospitals. Several independent variables were considered, including workload performed, facility operating capacity, size of GME program, geographic location of the facility, and type of facility (i.e., medical center, community hospital, or free-standing ambulatory clinic). The existence of economies of scale and scope was also investigated. A summary of the modeling methodology is presented next, and an attempt is made to identify the critical assumptions on which the analysis hinges. Then the estimated inpatient and ambulatory cost functions are presented.

A. GENERAL METHODOLOGY

The cost functions were developed both to better understand the relationship between costs and workload within DoD hospitals and to project total facility costs for various levels of workload. The cost functions are based on adjusted Medical Expense and Performance Reporting System (MEPRS) data, as described in Chapter II. Most of the

adjustment factors were based on analysis of FY90 MEPRS data, though there were a few exceptions.[1] Our preliminary modeling efforts were based exclusively on FY90 data. When the Section 733 Study began, the data for FY92 were not yet complete. Moreover, the data for FY91 are widely viewed as anomalous because of Operation Desert Storm. As the study progressed and FY92 data became available, we began to combine these new data with the FY90 data. We found that the regression relationships between cost and workload were statistically indistinguishable for the two fiscal years, once we corrected for the escalation in unit cost. Thus, we were able to combine the two years of data, thereby doubling the sample size for the regression analysis with an attendant increase in the precision of our estimates.

Specifically, we escalated the FY90 expenses by the average increase in cost per unit workload (i.e., cost per inpatient discharge or cost per ambulatory visit) observed between FY90 and FY92. Separate escalation factors were applied to the inpatient and ambulatory expense data, and to each facility type (i.e., medical center, community hospital, or clinic). These escalation factors are shown in Table III-1. The MEPRS adjustment factors, derived in Chapter II and repeated here in Table III-1, were applied to both the FY90 and FY92 MEPRS expense data. Then the escalation rates were applied only to the FY90 expenses, in order to express them in FY92 dollars.

Table III-1. Escalation Rates and MEPRS Adjustment Factors

	Inpatient Expenses	Ambulatory Expenses
FY90 to FY92 Cumulative Escalation Rate:		
Medical Centers	26.8%	27.3%
Community Hospitals	16.7%	23.5%
Clinics	Not Applicable	15.2%
MEPRS Adjustment Factors:		
Army	16.9%	13.2%
Air Force	12.8%	10.6%
Navy	13.3%	11.2%

1 The analysis of support-cost ratios used the time period FY87-FY90; the analysis of military-construction appropriations used the time period FY89-FY92; the analysis of MEPRS pay factors used the single year FY91.

The escalation rates shown in Table III-1 are surprisingly high. These are two-year cumulative rates, but the implied annual rates are still quite high (e.g., 12.6% for inpatient expenses in medical centers). These escalation rates cannot be strictly interpreted as price indices for medical care, because rapid technological advance invalidates the concept of comparing prices for a constant set of goods or services. In addition, some of the FY92 outlays may represent the spend-out of FY91 obligations made in connection with Operation Desert Storm.

The MEPRS cost-assignment methodology separates cost and workload into inpatient and ambulatory functional categories. To take advantage of the MEPRS methodology for allocating ancillary, support, and overhead costs to functional categories, separate inpatient and ambulatory cost functions were developed. The predictions of the two models may simply be added to predict total cost at a given facility. We also experimented with a model to predict combined inpatient and ambulatory costs, using separate inpatient and ambulatory workload measures as independent variables. However, we found a high correlation between the inpatient and ambulatory workload measures across facilities. The combined model suffered from unstable coefficient estimates as compared to the separate inpatient and ambulatory models eported here.

The cost models also required a weighting process to adjust for heteroskedasticity (i.e., non-uniform error variance within groups) as well as groupwise variance differences (i.e., differences in relative modeling error between medical centers, community hospitals and clinics). Through the use of weighted regression, with additional adjustments for groupwise differences, the basic assumption of constant variance (homoskedasticity) in the data was restored when applying least squares regression.

To better establish a baseline from which to construct military-hospital cost models, we reviewed previous work by Vector Research, Incorporated (VRI), on military-hospital cost functions, as well as numerous research publications on civilian-hospital cost functions. These papers aided in identifying potential independent variables that were considered for the cost functions. Table III-2 gives a brief summary of the findings contained in these papers.

We have summarized the procedure for developing the facility-level expenses used as the dependent variable in the cost functions, as well as the procedure for identifying potential independent variables. The remainder of this chapter describes the resulting inpatient and ambulatory cost functions.

Table III-2. Summary of Civilian-Hospital Cost Function Research

- Most models specified in the form of a log-log model (1, 3, 7) (others used were general linear--with scale and scope terms--or translog models)
- Teaching activity significantly contributes to higher total costs (1, 2, 3, 5, 6, 7)
- Diminishing marginal costs generally exist for hospitals having up to 300 beds (1, 2, 3, 5, 7)
- Outpatient visits by clinical area generally do not have significantly different cost coefficients (1, 3)
- Economies of scope exist between pediatric care and other inpatient care (2)
- Diseconomies of scope exist between emergency room services and inpatient care (1, 2, 7)
- Level of forecasted workload has a significant effect on costs (if forecasted workload is higher than realized workload, then incur excess capacity costs) (3, 4, 5, 7)
- Specialty care may be more expensive than general medical care even after case-mix adjustment (1, 3, 5)
- Inpatient care is frequently separated into discharges and bed days to measure the impact of changes in average length of stay

Note. The numbers refer to formal references, listed below, from which the statements were derived.

1. "Estimating Hospital Costs - A Multiple Output Analysis." Thomas W. Grannemann, Randall S. Brown, and Mark V. Pauly, *Journal of Health Economics*, No. 5, 1986, 107-127.
2. "Multiproduct Short-Run Hospital Cost Functions: Empirical Evidence and Policy Implications From Cross-Section Data." Thomas G. Cowing and Alphonse G. Holtman, *Southern Economic Journal*, Volume 49, January 1983, 637-653.
3. "Determinants of Hospital Costs-Outputs, Inputs, and Regulation In the 1980s." Jack Hadley and Stephan Zuckerman, Urban Institute Report 91-10, 1991.
4. "A New Approach to Hospital Cost Functions and Some Issues In Revenue Regulation." Bernard Friedman and Mark V. Pauly, *Health Care Financing Review*, No. 4, March 1983, 105-114.
5. "Hospital Output Forecasts and the Cost of Empty Hospital Beds." Mark V. Pauly and Peter Wilson, *Health Services Research*, Volume 21, August 1986, 403-428.
6. "Development of Cost Models to Support Diagnosis Related Management," VRI-DMIS-2.60 WP91-1R, Vector Research Incorporated, 7 November 1991.
7. "Why Are Urban Hospital Costs So High? The Relative Importance of Patient Source of Admission, Teaching, Competition, and Case Mix." Kenneth E. Thorpe, *Health Services Research*, Volume 22.6, February 1988.

B. INPATIENT COST FUNCTION

Two cost functions were developed: one for inpatient expense data and one for ambulatory expense data. MEPRS separately identifies inpatient and ambulatory costs, and uses a standard methodology for assigning ancillary, support and overhead expenses to each clinical area within the hospital. The inpatient cost function, based on expenses reported in the MEPRS A (Inpatient) accounts, is described next. The ambulatory cost function is discussed in a later section.

1. Construction of Case-Mix Adjusted Workload

The objective of this section is to develop a single, homogeneous work unit for inpatient care. It is well-known that different clinical procedures vary widely in resource

intensity. Simply adding the total number of discharges, without regard to the procedures performed, would not yield a homogeneous work unit even for a single facility. Moreover, it would be virtually impossible to compare unit costs across facility types. For example, community hospitals refer many of their most difficult cases to medical centers, so that medical centers would always appear more expensive unless some adjustment were made for complexity.

Our homogeneous work unit uses a weighting scheme for resource intensity based on Diagnosis Related Groups (DRGs). The DRG system provides a method for classifying inpatient care into over 500 groups having roughly similar within-group resource requirements. DRGs form the basis for prospectively determining hospital payments within the Medicare and CHAMPUS programs. By following a DRG schedule, hospitals that treat the more resource-intensive cases are credited with larger payments. We have applied DRGs in a reverse fashion from their conventional usage. We observe differences in unit costs across MTFs. We have used DRGs to rationalize part of these differences, effectively crediting the medical centers with more work units.

Specifically, we have assigned individual inpatient discharges from military hospitals to particular DRGs, based on the diagnoses, procedures performed, comorbidities and complications, and other factors. However, because (as mentioned in Chapter II) military hospitals do not have a patient-level accounting system, it is not possible to directly estimate an average cost by DRG for military hospitals. Instead, we have used the CHAMPUS FY91 (Version 8) DRG Grouper, with its associated average costs and outlier criteria.[2] The assumption here is that *relative* cost by DRG based on CHAMPUS experience provides a good predictor for (unobserved) relative cost by DRG in military hospitals.

Table III-3 presents a simplified, fictional example to illustrate how DRG-based case-mix adjustments work. In this example, a vaginal delivery is accompanied by either a normal newborn or a low-birthweight newborn, yielding a total of two discharges. The table demonstrates that the cost per discharge prior to case-mix adjustment ranges between \$400 and \$40,000. Because high-risk deliveries are typically identified in advance and referred to medical centers, a preponderance of low-birthweight infants are delivered in

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2 CHAMPUS FY91 (Version 8) DRG weights and outlier criteria were published in the *Federal Register*, Vol. 55, No. 214, November 5, 1990.

medical centers. Thus, prior to case-mix adjustment, one would expect a higher average cost per discharge at medical centers than at community hospitals.

Table III-3. Derivation of DRG Weights

DRG	Description	Total Cost	Total Discharges	Cost per Unadjusted Discharge	DRG Weight	Cost per DRG Weight
373	Vaginal Delivery	$14,240,000	5,000	$2,848	0.712	$4,000
391	Normal Newborn	$1,760,000	4,400	$400	0.100	$4,000
610	Low Birthweight Newborn	$24,000,000	600	$40,000	10.000	$4,000
	Total/Average:	$40,000,000	10,000	$4,000	1.000	$4,000

Continuing with this example, Table III-3 compares average costs before and after case-mix adjustment. The DRG weight is computed in each row of the table as the ratio of cost per unadjusted discharge, divided by the overall average cost (i.e., divided by $4,000). We see that average cost is equalized after application of the DRG weights, so that the cost and workload data at medical centers may be combined with the data from community hospitals, which are less likely to treat high-risk cases. For example, vaginal delivery (DRG 373), most likely performed at a community hospital, is counted in our data as 0.712 weighted discharges. The average cost per *weighted* discharge equals $4,000. Low-birthweight neonatal care (DRG 610), most likely provided at a medical center, is counted in our data as 10.0 weighted discharges. The average cost per *weighted* discharge again equals $4,000. By expressing workload in terms of weighted discharges, we have work units that are equally costly on average. Thus, the weighted discharges may be added to form a homogeneous predictor of total inpatient cost at a given facility.[3]

We should reiterate the fundamental assumption of this section: the relative cost by DRG based on CHAMPUS experience provides a good predictor for relative cost by DRG in military hospitals. Unfortunately, in the absence of a patient-level accounting system, there is no way to *directly* assign relative resource weights to individual discharges from military hospitals. Further research may be warranted to investigate the adequacy of using CHAMPUS DRG weights as a proxy.

3 In addition, for certain exceptional cases with extremely long or short stays, the DRG weight is not entirely appropriate. We have adjusted the weighted workload down for exceptionally short stays or up for exceptionally long stays. These adjustments were made in accordance with the outlier criteria and methodology used by CHAMPUS in FY91 for the Version 8 DRG Grouper.

2. Regression Estimates

Figure III-1 displays the relationship between inpatient expenses (FY90 and FY92 data measured in FY92 dollars) and inpatient case-mix adjusted workload (i.e., the sum of weighted discharges by facility), with symbols identifying the facilities by type. The scatterplot demonstrates that medical centers in general are larger than community hospitals in terms of total inpatient workload. Where the two facility types overlap, roughly between 8,000 and 14,000 discharges, medical centers have higher costs than community hospitals. This visual analysis, reinforced with statistical tests, indicated fundamental differences between the cost structures of medical centers and community hospitals. These differences were taken into consideration in the model through the use of facility-type dummy variables, where required. Also, while the scatter of points for medical centers appears linear, the scatter for community hospitals indicates decreasing marginal costs for the largest hospitals. This phenom. on was modeled by introducing a quadratic term (i.e., workload squared) for the community hospitals only.

Figure III-2 visually demonstrates that the FY90 data points are well interspersed with the FY92 data points after application of the escalation rates. Thus the escalation rates we used seem appropriate. In addition, statistical tests indicated that the separate regression relationships for the two years were indistinguishable, thereby justifying our decision to combine them into a single cost function.

The inpatient cost-function parameter estimates, summary statistics, and data point exclusions are presented in Table III-4. As indicated by visual inspection of Figure III-1, the regression function is linear for medical centers, but includes a quadratic effect (i.e., decreasing marginal costs) for community hospitals.[4] The model also reveals that facility operating capacity and GME intensity are significant predictors of inpatient expenses. Recall that operating capacity was measured by the number of operating beds, and GME intensity was measured by the number of residents and interns enrolled at an MTF. Recall

4 The literature on civilian-hospital cost functions, as summarized previously in Table III-2, often uses more exotic mathematical functions than our linear-quadratic. For example, the translog function is sometimes used to account for sample variation in the prices of inputs such as labor and materials. We suspect that price variation across MTFs is minimal; the largest component of cost, military labor, shows no price variation at all. Consistent with this hypothesis, we found no evidence of geographical variation in total inpatient cost across MTFs. Therefore, we saw no need to consider the translog function.

also that we used FY92 reported operating beds for both fiscal years, because the FY90 reported operating-bed data were judged unreliable.

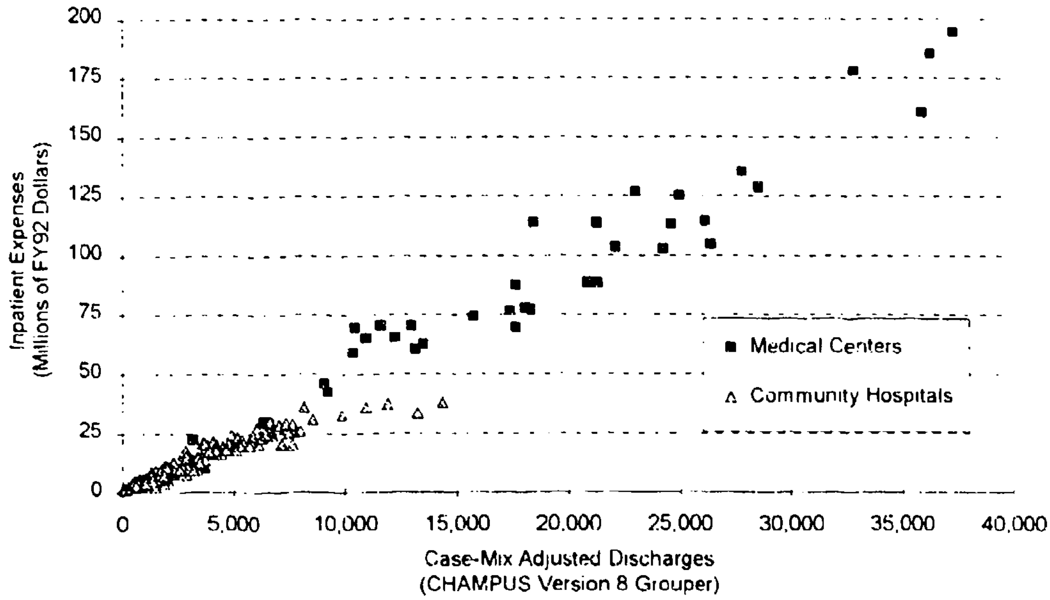


Figure III-1. FY90 and FY92 Inpatient Expenses (FY92 Dollars), by Facility Type

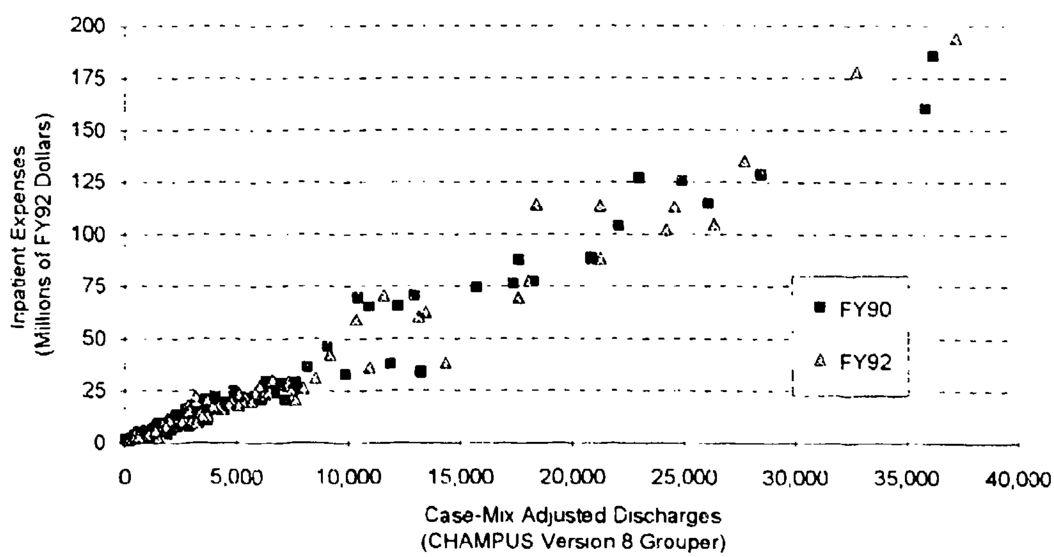


Figure III-2. FY90 and FY92 Inpatient Expenses (FY92 Dollars), by Fiscal Year

Table III-4. Final Inpatient Model

Model Functional Form:

Inpatient Expenses = (Intercept + Community Hospital Intercept Adjustment + B1*Case-Mix Adjusted Discharges + B2*Community Hospital Case-Mix Adjusted Discharges + B3*Community Hospital Case-Mix Adjusted Discharges Squared + B4*Operating Beds + B5*GME) * (1 + B6*NAVY)

Variables	Mean Value	Coefficient Estimate	t-Statistic	95% Confidence Interval	
Intercept		9,548,815	2.474	1,942,709	17,154,921
Community Hospital Intercept Adj.		-8,467,472	-2.193	-16,076,618	-858,325
Case-Mix Adjusted Discharges (CMAs)	5,321	2,979	7.990	2,244	3,714
Community Hospital CMA Adj.	2,314	+223	0.590	-523	969
Community Hospital CMAs Squared	1.07e+7	-0.0601165	-2.728	-.1035426	-.0166905
Operating Beds	103	35,256	5.005	21,373	49,138
GME (Residents & Interns)	31	65,862	2.910	21,254	110,471
Navy % Adjustment		7.36%	2.690	1.97%	12.76%

The following data points were removed from the model before estimation:

Facility Name	Fiscal Year	Reason
Letterman	FY92	Structural
Womack	FY90, FY92	High Leverage
NH Newport	FY92	Outlier
Cutler	FY90, FY92	Missing Data
BH NAVSTA Adak	FY92	Missing Data
509th Strategic Hospital	FY90, FY92	Missing Data
354th Medical Group	FY90, FY92	Missing Data

Number of valid observations: 227

The coefficients are interpreted in the following manner:

- Intercept: The cost that would be predicted at a medical center if all regression variables were set to zero. Because medical centers are never observed in this situation, the confidence interval is extremely wide; the estimate involves extrapolation well outside the range of observed data. Moreover, the estimate is counterfactual because it considers a medical center with not only zero inpatient workload, but also zero bed capacity.
- Community Hospital Intercept Adjustment: The difference between the medical-center intercept and community-hospital intercept; the resulting community-hospital intercept is $1.08 million.

- Case-Mix Adjusted Discharges (CMAs): The marginal cost of producing an additional discharge at a medical center.
- Community Hospital CMA Adjustment: The difference between the marginal cost of producing an additional discharge at a community hospital, versus the marginal cost of producing an additional discharge at a medical center, *prior* to adjusting for the diminishing marginal costs identified at the former. Thus, the marginal cost of the first discharge from a community hospital equals $2,979 plus $223, or $3,202. We retain the difference, $223, even though it is not statistically significant, because it represents our best point estimate.
- Community Hospital CMAs Squared: The square of discharges is used as an independent variable to identify potential increasing or decreasing marginal costs with increases in workload. The negative coefficient implies that marginal costs decrease with an increase in workload (i.e., economies of scale).
- Operating Beds: Staffed beds that are ready to be occupied by patients (operating beds) are a measure of a hospital's operating capacity. The coefficient represents the cost of each staffed bed, and is a combination of fixed (i.e., physical plant) and marginal (i.e., staff) costs.
- GME (Residents and Interns): An estimate of the additional *patient-care* cost incurred by providing graduate medical education, measured in terms of cost per enrolled resident or intern. This estimate reflects student FTEs charged directly to the MEPRS A (Inpatient) account. It also reflects classroom time factored into total expenses via the FAK-account (Student Expenses) adjustment, as described in Chapter II. Recall, however, that the FAK accounts were spread as system-wide overhead, rather than being assigned directly (and exclusively) to teaching facilities.
- Navy % Adjustment: Due to structural and accounting differences, it was necessary to include a variable to distinguish Navy facilities from Army and Air Force facilities.

The Navy adjustment should *not* be interpreted as evidence that Navy hospitals are more expensive or less efficient than Army or Air Force hospitals. Although MEPRS purports to be a standardized accounting system, there are workload and cost-accounting differences between the Services that cannot be explained through econometric modeling given the variables at hand. We expand on this point later in the section on ambulatory cost models. We present comparisons between medical workload as reported in the accounting systems, and medical workload as self-reported by beneficiaries in the 1992 DoD Health Care Survey. The accounting systems report more workload than the survey,

but the difference is less pronounced for the Navy than for the other two Services. Thus, the accounting systems may understate Navy workload (or overstate it less), fostering the appearance of higher unit cost for that Service. Further research is clearly warranted to improve the comparability of cost and workload data across the three Services.

Inpatient marginal costs are constant with respect to workload for medical centers, but decrease over the range of data for community hospitals. The model estimates of marginal cost are depicted in Figure III-3. At a level of approximately 1,860 total discharges, the marginal cost of a discharge at a medical center is equal to the marginal cost of a discharge at a community hospital. Therefore, very small community hospitals appear most expensive on the margin. Marginal costs for community hospitals remain positive until the point of approximately 26,600 discharges. This level is substantially greater than the highest observed value of 14,363 discharges for community hospitals, and well beyond the relevant range of application of the cost function for community hospitals.

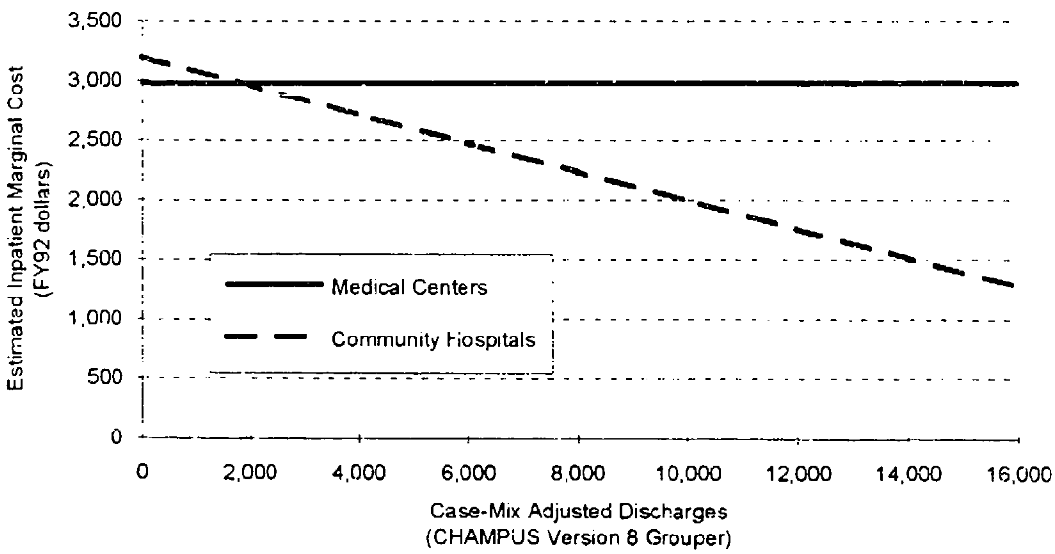
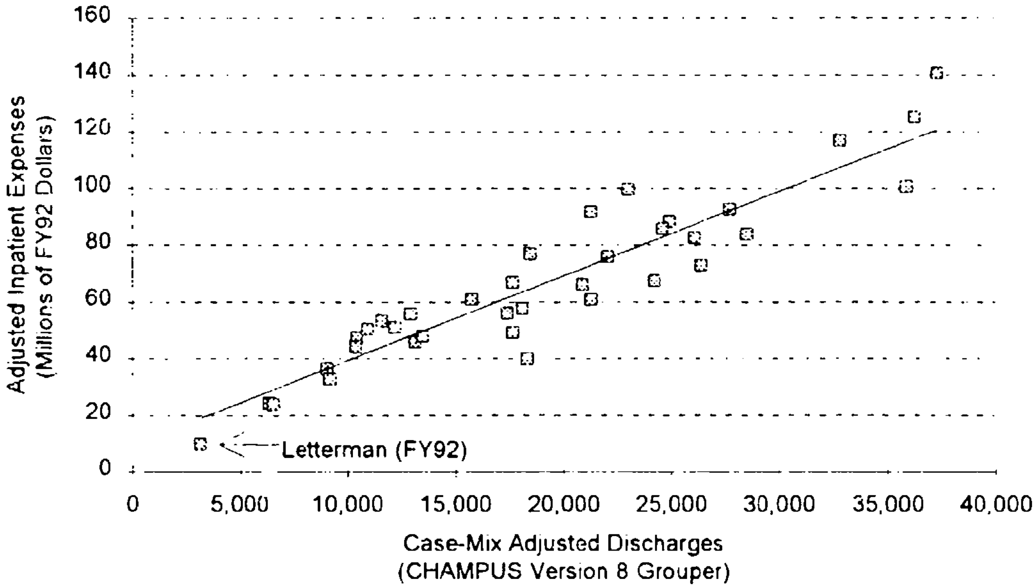


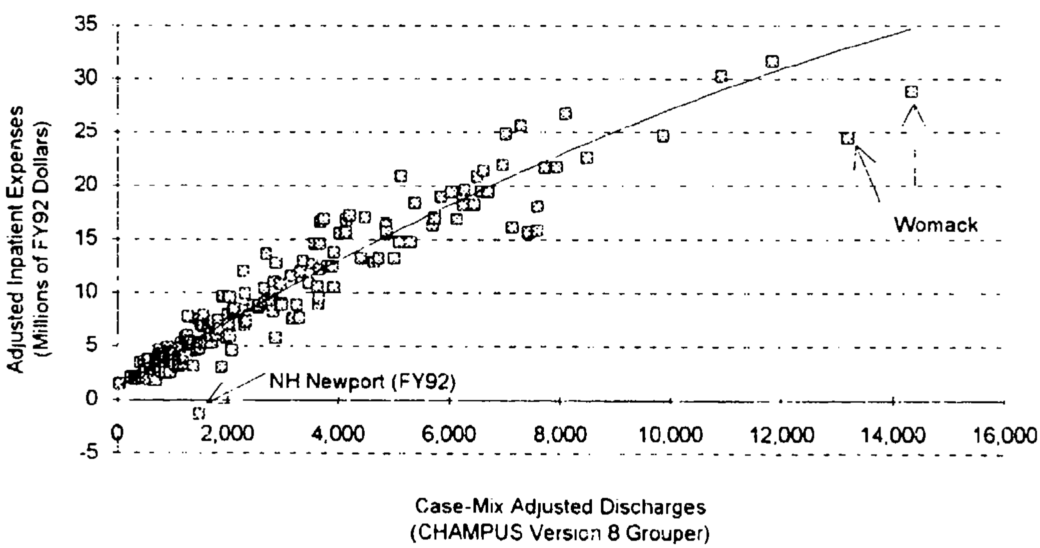
Figure III-3. Inpatient Marginal Cost Versus Workload, by Facility Type

Figures III-4 and III-5 display the relationship between total inpatient expenses and workload, respectively, for medical centers and community hospitals, after adjusting for all independent variables other than case-mix adjusted discharges. As shown previously in Table III-4, several data points were excluded from the model for various reasons. FY92 data for Letterman Army Medical Center were removed because operations were



Note: Expenses adjusted for other regression right-hand variables.

Figure III-4. Medical Center Inpatient Expenses Versus Workload (FY92 Dollars)



Note: Expenses adjusted for other regression right-hand variables.

Figure III-5. Community Hospital Inpatient Expenses Versus Workload (FY92 Dollars)

substantially reduced in preparation for closing, making this an atypical observation. Womack Army Hospital at Fort Bragg was excluded because this facility had undue influence on the regression parameters. Inclusion of this facility would yield a much stronger quadratic effect (i.e., more rapidly decreasing marginal cost), that is not suggested by the other community hospitals in the data set. Naval Hospital Newport was not a representative data point because its observed expenses were more than three standard deviations from the regression line. Finally, several facilities did not report expenses, workload, or operating beds for a particular fiscal year, and were necessarily excluded from the model.

Figure III-6 is a histogram of the percentage deviations between the observed inpatient expenses and the predicted inpatient expenses. Positive values indicate that observed expenses exceed predicted expenses. Only those facilities that were included in the regression are shown in the histogram, thereby indicating the goodness-of-fit of the regression line relative to the data from which it was estimated. With the possible exception of the two endpoints, the histogram indicates a normal distribution of the percentage errors, implying that the statistical properties of the regression model are sound.

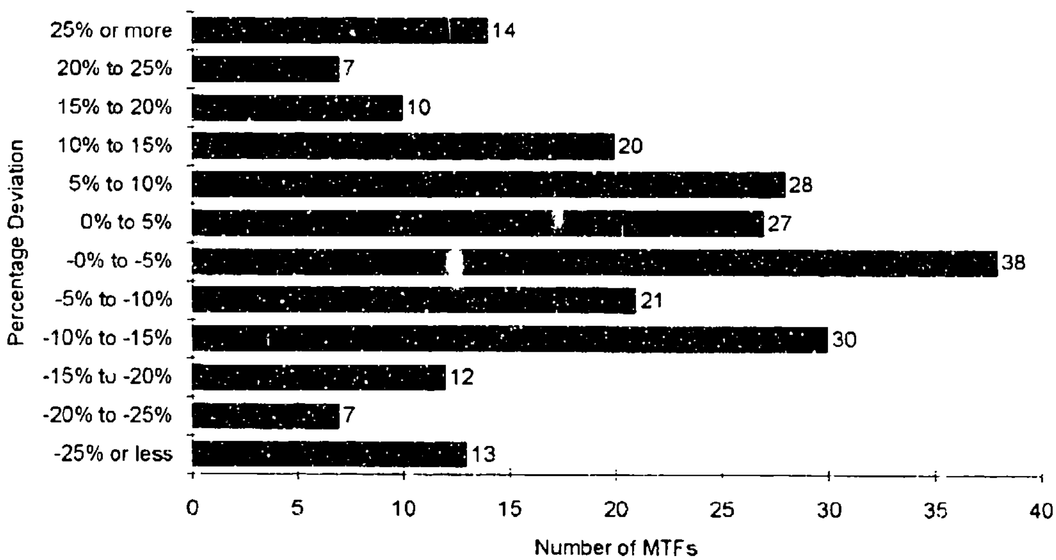


Figure III-6. Percentage Deviation Between Observed and Predicted Inpatient Expenses

The relatively high mass at each endpoint (i.e., errors of 25% or more) indicates that we were conservative in discarding data points. These data points were retained, despite the large percentage errors, because they fell within three standard deviations of the regression line. As demonstrated in Figure III-5, the observed costs for a given level of workload vary substantially in the basic data. For example, the observed costs to produce 8,000 discharges, after adjusting for other independent variables, range between approximately $15 million and $27 million, an 80-percent spread. With this much spread in the basic data, it is inevitable that a few data points will stray from the regression line.

It is important to remember that the cost functions were not developed to estimate resource requirements for a particular facility. Rather, they were developed to estimate the change in system-wide costs as the aggregate level of workload is changed. The cost functions presented here are more than adequate for the task, and predict hospital costs at least as well as most of their counterparts in the literature on civilian-hospital costs cited previously in Table III-2.

C. AMBULATORY COST FUNCTION

The ambulatory cost function was developed in a similar manner to the inpatient cost function. Because most ambulatory care in the civilian sector is not provided at hospitals, there was little basis for comparison between the civilian and military sectors in this case. Nor was there any system comparable to DRG weights to enable an adjustment for relative resource-intensity. Before turning to the regression estimates, we must discuss the workload exchange rates. These rates were developed by the Section 733 Study to reflect the differences between medical workload as reported in the accounting systems, and medical workload as self-reported by medical beneficiaries.

1. Workload Exchange Rates

The RAND Corporation used data from the 1992 DoD Health Care Survey[5] to calibrate its models that forecast utilization under analytical cases. RAND then provided IDA with inpatient and ambulatory workload estimates for each analytical case. However, the amount of medical workload differs, often dramatically, between MEPRS and the

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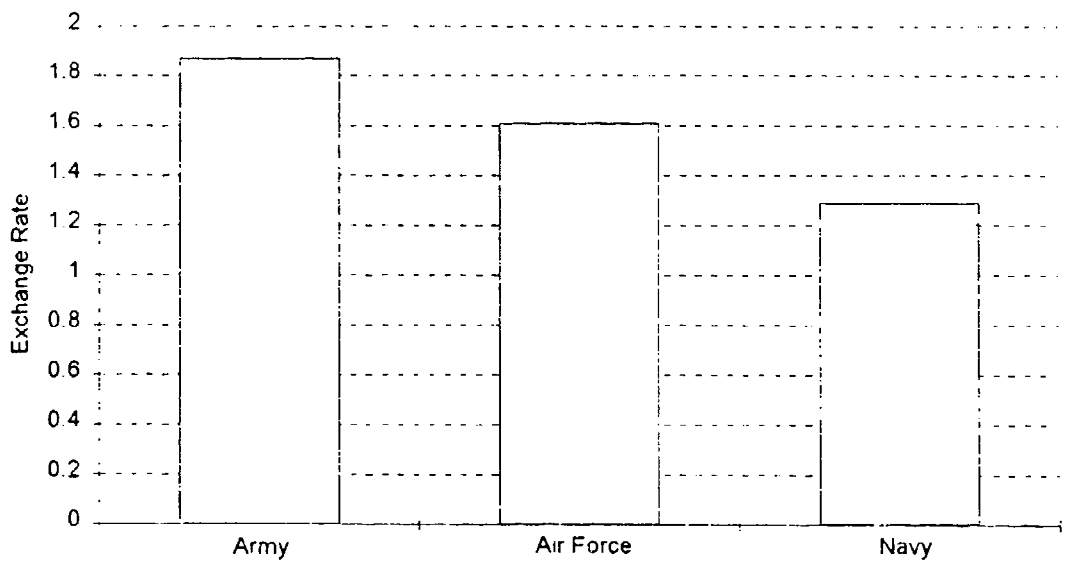
[5] The survey design and findings are documented in Philip M. Lurie, et al., "Analysis of the 1992 DoD Survey of Military Medical Care Beneficiaries," Institute for Defense Analyses, Paper P-2937, forthcoming, 1994.

beneficiary survey. Thus, the hypothetical workloads are measured along one scale, but the IDA cost functions require workload measured along a different scale. A conversion is clearly necessary to make the RAND workload numbers "fit" into the IDA cost functions.

To circumvent this problem, RAND has computed a set of "exchange rates," which play a role analogous to the rates used in converting two currencies (e.g., dollars to yen). RAND has computed the exchange rates along various dimensions (e.g., inpatient versus outpatient care, beneficiary category, and Service branch).[6] As an example, Figure III-7 shows the exchange rates, by Service branch, for ambulatory visits. The figure reveals that more workload is reported in MEPRS than in the beneficiary survey, but the difference is less pronounced for the Navy than for the other two Services.



Note. FY92 ambulatory visits reported in MEPRS, divided by ambulatory visits estimated from the beneficiary survey.

Figure III-7. Ambulatory-Workload Exchange Rates, by Service Branch

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6 The complete set of exchange rates is available in Susan D. Hosek, Bruce W. Bennett, Kimberly A. McGuigan, Jan M. Hanley, Roger Madison, and Afshin Rastegar, "The Demand for Military Health Care: Supporting Research for a Comprehensive Study of the Military Health Care System," RAND Corporation, MR-407-PA&E, January 1994.

A critical assumption is being made when using the exchange rates to "fit" hypothetical workload numbers into the IDA cost functions. Specifically, it is being assumed that the historical relationships between the two measurement systems will be maintained under the analytical cases. For example, suppose that the beneficiary survey initially shows 100 visits to Air Force hospitals, whereas MEPRS data show 160 visits (reflecting the Air Force exchange rate of 1.6). If survey-based analysis predicts a 10% increase to 110 visits, then the new workload figure for the MEPRS-based cost function also increases by 10%, to 176 visits. As long as the exchange rate remains constant at 1.6 under the analytical case, this procedure is valid. The procedure would fail only if some feature of the analytical case drove a wedge between the incentives to report workload under the two systems. Although we are not aware of any such feature, the calculation and use of exchange rates between data systems requires additional research

2. Regression Estimates

The ambulatory cost function was estimated using expenses reported in the MEPRS B (Ambulatory) accounts. The MEPRS adjustment factors, derived in Chapter II, were applied to both the FY90 and FY92 MEPRS expense data. Then the escalation rates were applied only to the FY90 expenses, in order to express them in FY92 dollars.

Figure III-8 displays the relationship between ambulatory expenses (FY90 and FY92 data measured in FY92 dollars) and the number of visits, with symbols identifying the facilities by type. Again, we see different cost structures for different classes of facilities. Total costs are generally highest at medical centers, even in the wide region of overlap with community hospitals. The scatter for community hospitals again indicates decreasing marginal costs. These phenomena were modeled using facility-type dummy variables, plus a quadratic term for the community hospitals only.

The data include a total of 35 observations over the two years on clinics outside of the continental United States (OCONUS). As is shown later, inclusion of the OCONUS clinics had virtually no effect on the coefficient estimates, but did improve their precision by increasing the sample size. Finally, as previously discussed for the inpatient model, there is large variation in observed expenses for a given level of workload. For example, facilities operating at roughly 900,000 visits per year report expenses ranging between approximately $50 million and $110 million, a 120-percent spread.

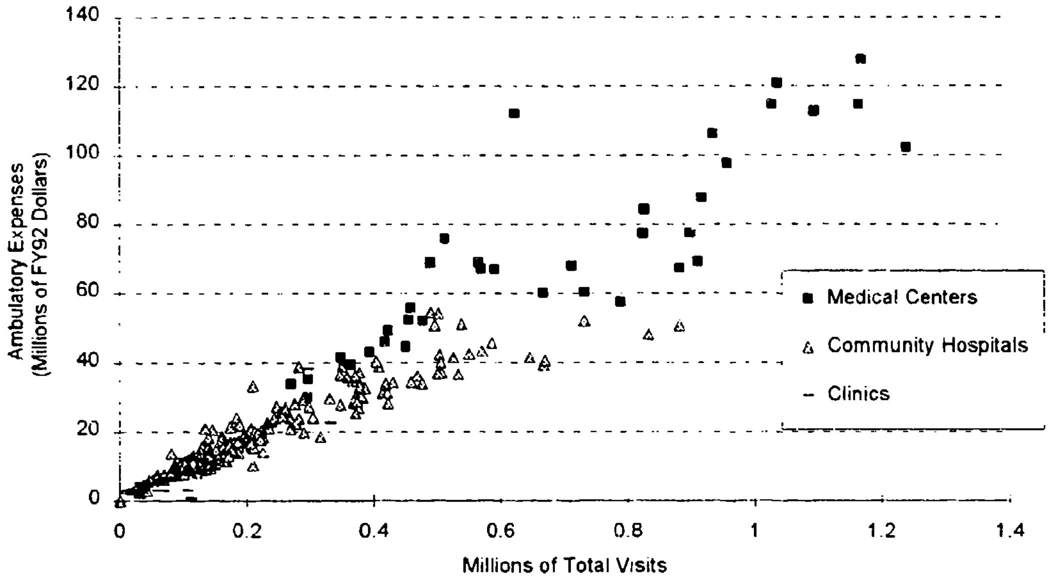

Figure III-8. FY90 and FY92 Ambulatory Expenses (FY92 Dollars), by Facility Type

Figure III-9 visually demonstrates that the FY90 data points are again well interspersed with the FY92 data points after application of the escalation rates. Statistical tests indicated that the separate regression relationships for the two years were indistinguishable, thereby justifying our decision to combine them into a single cost function.

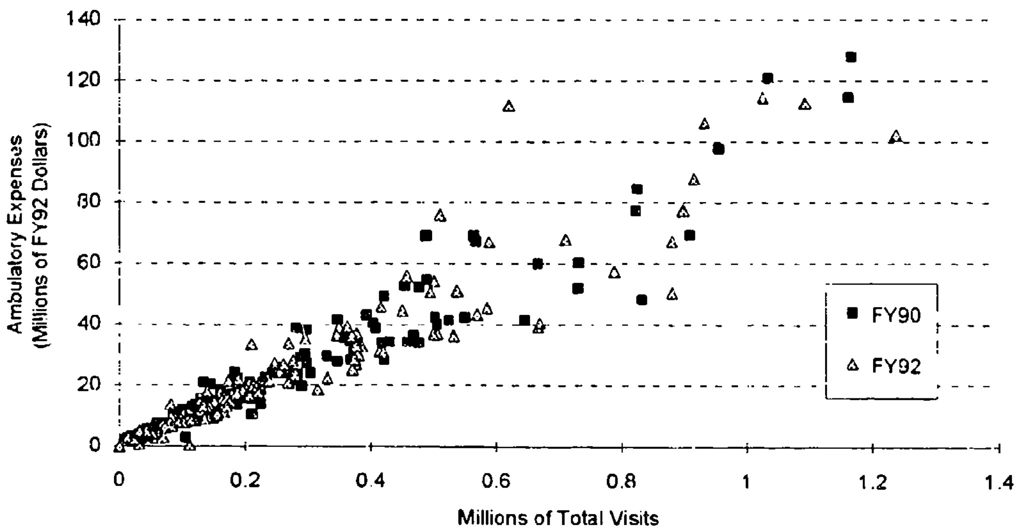

Figure III-9. FY90 and FY92 Ambulatory Expenses (FY92 Dollars), by Fiscal Year

The ambulatory cost-function parameter estimates, summary statistics, and data point exclusions are presented in Table III-5. The regression function is linear for medical centers and clinics, but includes a quadratic effect (i.e., decreasing marginal costs) for community hospitals.

Table III-5. Final Ambulatory Model

Model Functional Form:

Ambulatory Expenses = (Intercept + Community Hospital Intercept Adjustment + Clinic Intercept Adjustment + B1*Total Visits + B2*Community Hospital Total Visits + B3*Clinic Total Visits + B4*Community Hospital Total Visits Squared + B5*GME) * (1 + B6*NAVY)

Variables	Mean Value	Coefficient Estimate	t-Statistic	95% Confidence Interval	
Intercept		19,814,482	5.146	12,113,576	27,515,388
Community Hospital Intercept Adj.		-19,919,506	-5.147	-27,659,104	-12,179,908
Clinic Intercept Adj.		-18,633,084	-4.834	-26,342,532	-10,923,636
Total Visits	217,676	42	4.370	23	61
Community Hospital Total Visits	144,141	+58	5.583	38	79
Clinic Total Visits	17,769	+27	2.634	7	47
Community Hospital Total Visits Squared	4.87e+10	-0.0000527	-7.927	-.0000658	-.0000396
GME (Residents & Interns)	16	102,915	5.281	64,564	141,266
Navy % Adjustment		12.41%	5.475	7.95%	16.87%

The following data points were removed from the model before estimation:

Facility Name	Fiscal Year	Reason
NH Oakland	FY90, FY92	High Leverage
NH Portsmouth	FY90, FY92	High Leverage
NH San Diego	FY90, FY92	High Leverage
Letterman	FY92	Structural
Walter Reed	FY90	High Leverage
509th Strategic Hospital	FY92	Missing Data
7020th ABG Clinic	FY92	Missing Data
Air University	FY90	Outlier
NH Long Beach	FY90, FY92	Outlier
Port Hueneme	FY90, FY92	Outlier
Bethesda	FY92	Outlier
NH Patuxent River	FY92	Outlier
Kimbrough AH	FY92	Outlier
NH Corpus Christi	FY92	Outlier
Pearl Harbor	FY90	Outlier

Number of valid observations: 308

The coefficients are interpreted in the following manner:

- Intercept: The cost that would be predicted at a medical center if all regression variables were set to zero. Because medical centers are never observed in this situation, the confidence interval is extremely wide; the estimate involves extrapolation well outside the range of observed data.
- Community Hospital Intercept Adjustment: The difference between the medical-center intercept and community-hospital intercept. The net result is an intercept that is negative but not significantly different from zero at the 95% confidence level.
- Clinic Intercept Adjustment: The difference between the medical-center intercept and clinic intercept. The net result is an intercept of approximately $1.2 million, which is significantly different from zero at the 95% confidence level.
- Total Visits: The marginal cost of producing an additional visit at a medical center.
- Community Hospital Total Visits: The difference between the marginal cost of producing an additional visit at a community hospital, versus the marginal cost of producing an additional visit at a medical center, *prior* to adjusting for the diminishing marginal costs identified at the former. Thus, the marginal cost of the first visit at a community hospital equals $42 plus $58, or $100.
- Community Hospital Total Visits Squared: The square of the visits is used as an independent variable to identify potential increasing or decreasing marginal costs with increases in workload. The negative coefficient implies that marginal costs decrease with an increase in workload (i.e., economies of scale).
- Clinic Total Visits: The difference between the marginal cost of producing an additional visit at a clinic, versus the marginal cost of producing an additional visit at a medical center. Because there is no evidence of economies of scale for clinics, the marginal cost of a visit is $42 plus $27, or $69 for all levels of clinic workload.[7]

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7 To determine whether CONUS and OCONUS clinics have the same cost structure, we reestimated the regression after deleting the OCONUS clinics. The result was a marginal cost of $73. The estimate of $69 reported in the text is more precise (i.e., has a smaller standard error), because it is based on more observations. For this reason, and because the two estimates are so close, we view $69 as our best estimate of the marginal cost for clinics.

- GME (Residents and Interns): An estimate of the additional *patient-care* cost incurred by providing graduate medical education, measured in terms of cost per enrolled resident or intern. This estimate reflects student FTEs charged directly to the MEPRS B (Ambulatory) account. It also reflects classroom time factored into total expenses via the FAK-account (Student Expenses) adjustment, as described in Chapter II. Recall, however, that the FAK accounts were spread as system-wide overhead, rather than being assigned directly (and exclusively) to teaching facilities.
- Navy % Adjustment: Due to structural and accounting differences, it was necessary to include a variable to distinguish Navy facilities from Army and Air Force facilities.

As previously discussed, the Navy adjustment should *not* be interpreted as evidence that Navy hospitals are more expensive or less efficient than Army or Air Force hospitals. The Navy exchange rate in Figure III-7 is 20% lower than the Air Force rate, and 31% lower than the Army rate. The Navy's apparent conservatism in recording MEPRS workload could easily explain the 12.4% difference in unit cost identified in the regression analysis. However, further research is clearly warranted to improve the comparability of cost and workload data across the three Services.

Ambulatory marginal costs are constant with respect to workload for medical centers and clinics, but decrease over the range of data for community hospitals. The model estimates of marginal cost are depicted in Figure III-10. Marginal costs for community hospitals fall to zero at a level of approximately 950,000 total visits, which is nearly 70,000 more than the highest observed value for community hospitals. The marginal cost for medical centers equals the marginal cost for community hospitals at a level of roughly 554,000 total visits; only five community hospitals operate at this level or greater. The marginal cost for clinics equals the marginal cost for community hospitals at a level of approximately 300,000 visits; about one-quarter of all community hospitals operate at this level or greater.

The estimates of patient-care costs associated with GME in the inpatient and ambulatory cost functions are additive. That is, for each resident or intern enrolled in an average teaching facility's GME program, the increase in patient-care cost is estimated as $65,862 for inpatient care plus $102,915 for ambulatory care. Thus, the total addition to patient-care cost at the average teaching facility is estimated as $168,777 per resident and intern. This estimate is clearly too high to represent simply the salaries of the medical

students. It represents, more generally, the different approach to medical care that is pursued at teaching hospitals.[8]

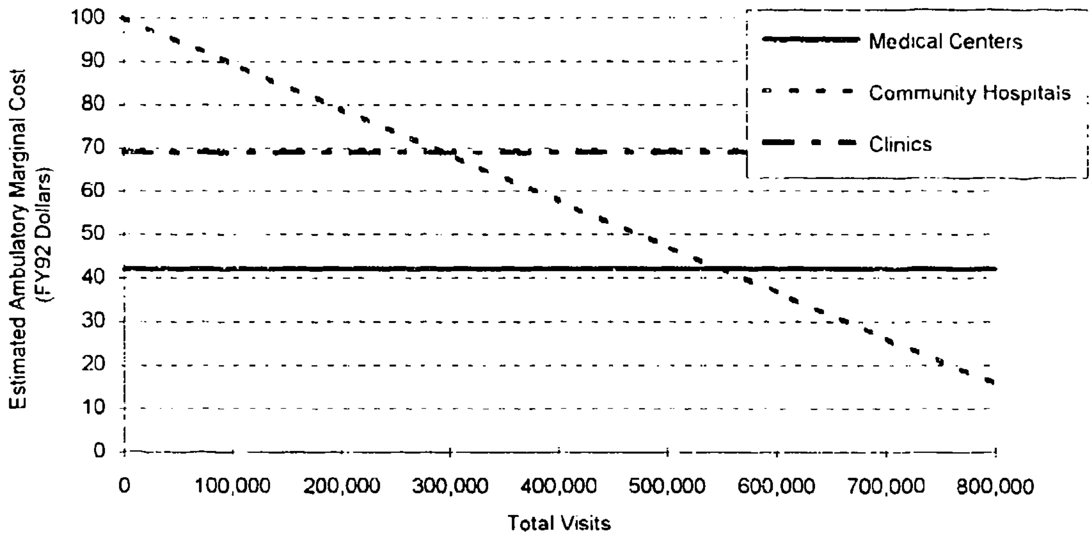

Figure III-10. Ambulatory Marginal Cost Versus Workload, by Facility Type

It is difficult to compare the estimate for ambulatory care with the civilian sector, because ambulatory care in the civilian sector is generally not provided at hospitals. Regarding inpatient care, recall that we measure GME by the headcount of enrolled residents and interns, whereas HCFA divides the headcount by the number of staffed beds in computing its hospital reimbursement factor. We experimented with some inpatient cost models in which we divided the headcount by reported operating beds, recognizing that operating beds are an imperfect measure of capacity. We found coefficients on this variable quite similar to those used in the HCFA reimbursement formula.[9] However, more research is needed to assess the efficiency with which military hospitals provide GME.

Figures III-11 through III-13 display the relationships between total ambulatory expenses and workload, for each facility type, after adjusting for the effects of GME and

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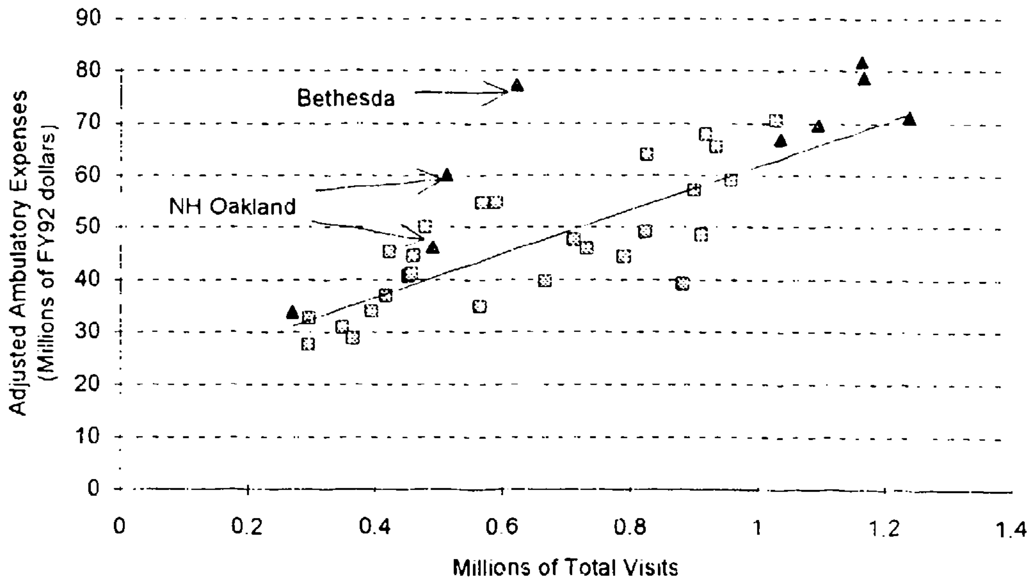
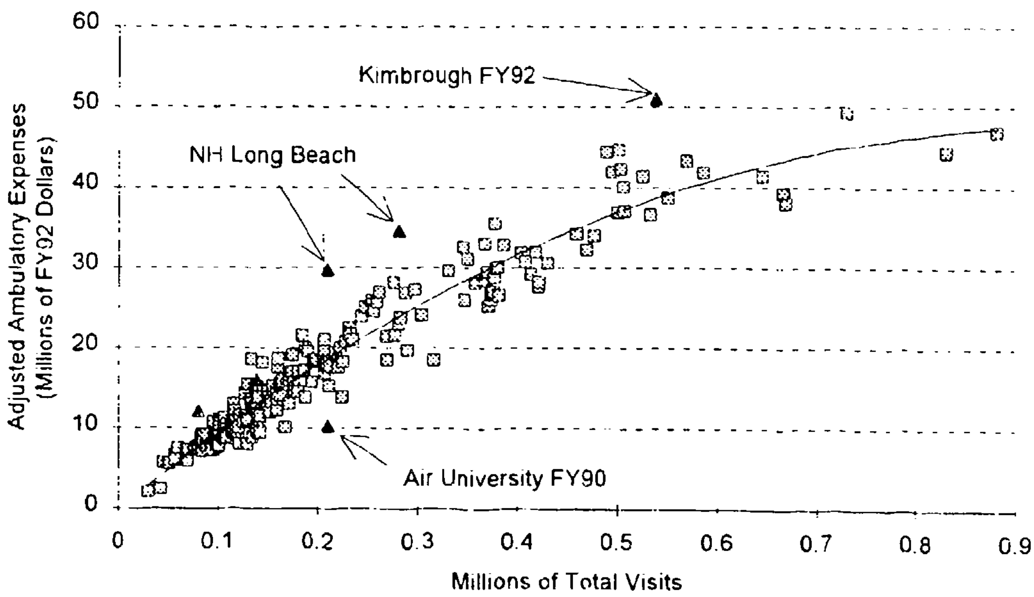
[8] One important component of the difference is shown in the EBE (Graduate Medical Education Support) and EBF (Education and Training Program Support) accounts of MEPRS. As indicated in Chapter II, these two accounts are stepped-down to the Inpatient and Ambulatory accounts, and are thereby reflected in our regression equations. These accounts record expenses accrued primarily at teaching hospitals (e.g., instructor salaries, medical library, medical illustration, and medical photography).

[9] Health Care Financing Administration (HCFA), *Federal Register*, Vol. 52, No. 169, September 1, 1987.



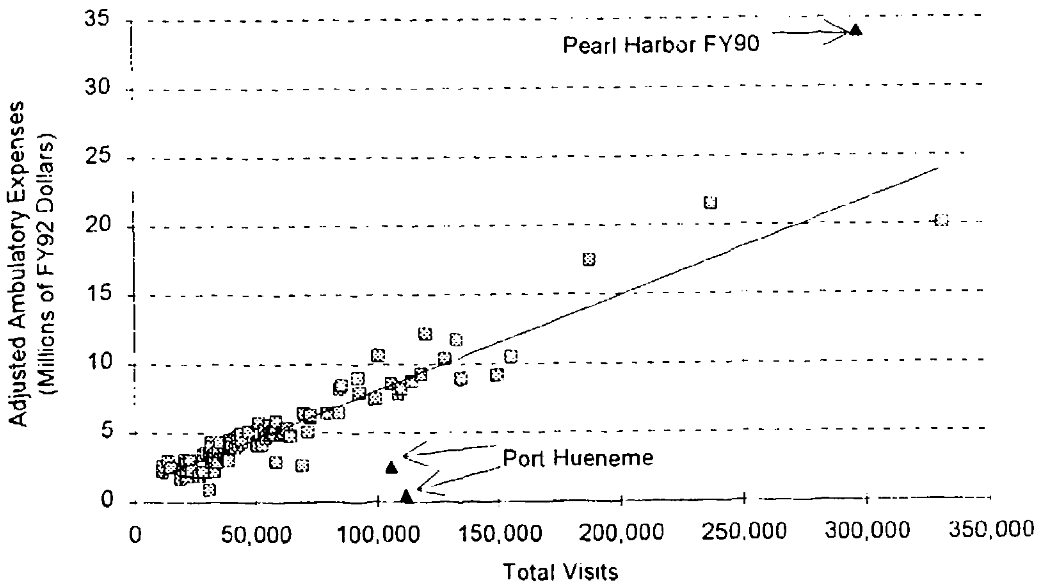
Note. Expenses adjusted for other regression right-hand variables.

Figure III-11. Medical Center Ambulatory Expenses Versus Workload (FY92 Dollars)



Note: Expenses adjusted for other regression right-hand variables.

Figure III-12. Community Hospital Ambulatory Expenses Versus Workload (FY92 Dollars)



Note: Expenses adjusted for other regression right-hand variables.

Figure III-13. Clinic Ambulatory Expenses Versus Workload (FY92 Dollars)

Service branch. Recall from Table III-5 that several data points were excluded from the model as outliers, highly-leveraged data points, or facilities with missing data. Data points excluded from the regression are indicated by triangular symbols; the most extreme such data points are also identified by facility name. Again, FY92 data for Letterman Army Medical Center were removed because operations were reduced in preparation for closing. All data points identified as outliers have observed expenses more than three standard deviations from the regression line.

Seven data points were removed due to having high leverage. These data points have undue influence on one or more of the regression parameters. A two-dimensional scatterplot of costs versus workload may show these data points near the regression line. However, a scatterplot of costs versus number of residents and interns, after adjusting for workload, may show that a particular facility has undue influence on the GME coefficient, perhaps because its GME program is substantially larger than those at most other facilities. The method used to identify highly-leveraged data points considers each independent variable in turn, and compares the value of that variable for each facility relative to the mean across all facilities. The influence on the regression model as a whole is then

considered to determine whether or not each point is highly leveraged.[10] The data points excluded, primarily a few of the Navy medical centers, typically caused substantial changes in the Navy adjustment, the GME coefficient, or the marginal cost of a medical-center visit. Based on analysis of the alternative models generated when including or excluding these data points, it was determined that the model selected here best represents the data set as a whole.

Figure III-14 is a histogram of the percentage deviations between the observed ambulatory expenses and the predicted ambulatory expenses. Positive values again indicate that observed expenses exceed predicted expenses. Only those facilities used in the regression analysis are included in this histogram. The histogram indicates a normal distribution of percentage deviations from the regression line. Also, the mass at each endpoint again indicates that we were conservative in discarding data points.

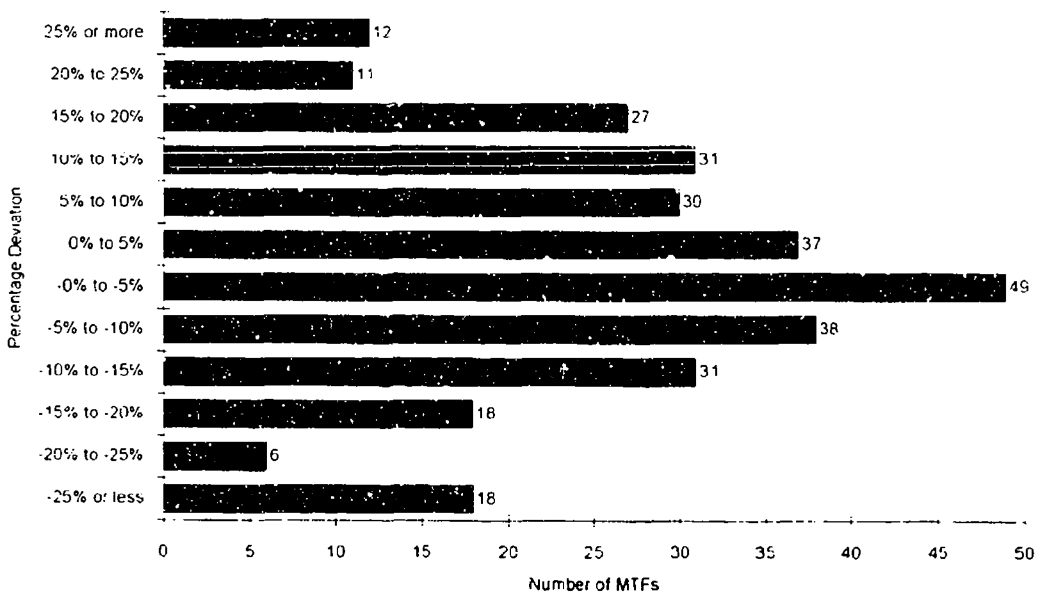


Figure III-14. Percentage Deviation Between Observed and Predicted Ambulatory Expenses

Several additional independent variables were considered in an attempt to improve the model fit, including geographic variation in labor or total costs, economies or diseconomies of scope (i.e., facilities that offer a greater variety of services experience

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[10] See D. A. Belsley, E. Kuh, and R. E. Welsch, *Regression Diagnostics*, New York: Wiley, 1980; or R. D. Cook and S. Weisberg, *Residuals and Influence in Regression*, London: Chapman Hall, 1982.

lower or higher marginal costs), and demographics of the patient population served. However, none of these variables were significant in reducing the error in our models.

D. SUMMARY OF MTF COST FUNCTIONS

The inpatient and ambulatory cost functions just described will be used to cost the hypothetical workloads corresponding to the analytical cases. The RAND Corporation is conducting the utilization analysis of each analytical case RAND has provided IDA with inpatient and ambulatory workload estimates for each analytical case, as well as any changes to operating-bed capacity or the volume of GME. Prior to delivering the workloads to IDA, RAND applied the appropriate exchange rates. Once again, these exchange rates are valid only if the historical relationships will be maintained between workload as reported in the accounting systems and workload as self-reported in the survey data. Because the link between survey-based utilization and the accounting data is critical for making cost-effectiveness comparisons, the exchange rates clearly warrant further research.

IV. COST ESTIMATES FOR THE ANALYTICAL CASES

This chapter contains the estimates of Military Treatment Facility (MTF) costs for the hypothetical workloads corresponding to the analytical cases. Before presenting the detailed cost estimates, we motivate the cases considered by developing a decomposition of the total change in cost into efficiency and demand effects. This decomposition addresses the issue of whether or not total (i.e., MTF plus CHAMPUS) workload is held constant when evaluating the net change in cost. Next, we give a brief summary description of the analytical cases considered, in terms of changes in the inpatient and ambulatory workloads at MTFs and changes in operating-bed capacity. We then present the detailed estimates of MTF cost for each case. Finally, we discuss "below the line" cost elements that are not explicitly modeled by either IDA or RAND, but that must be added to the IDA and RAND figures to round-out the estimate of total peacetime medical expenditures.

A. DECOMPOSITION OF EFFICIENCY AND DEMAND EFFECTS

A major objective of the 733 Study is to determine whether it is more cost-effective to expand MTF capacity and move workload in-house or, conversely, to reduce MTF capacity and move workload into CHAMPUS. This question can be answered by combining IDA's cost functions for in-house medical care with the CHAMPUS cost estimates developed by RAND. This section demonstrates the procedure for combining the IDA and RAND cost estimates. The numerical examples in this section are purely illustrative, and do not reflect actual cost estimates.

An important concept in performing this analysis is the *tradeoff factor*. Suppose that MTF capacity is increased, yielding 100 additional MTF visits. If the number of CHAMPUS visits decreases by exactly 100, then the tradeoff factor is 1.0. However, it is likely that the increase in MTF visits will exceed the reduction in CHAMPUS visits. Co-payments are zero for outpatient care provided in MTFs, but range between 20% and 25% for outpatient care provided under CHAMPUS. With the availability of more *free* care, 100 MTF visits might replace 80 CHAMPUS visits. The tradeoff factor is defined as the ratio of the increase in MTF visits, divided by the decrease in CHAMPUS visits.

For analytical purposes, it is useful to partition the change in total cost into an efficiency effect and a demand effect. The efficiency effect is defined as the change in total (MTF plus CHAMPUS) cost when the tradeoff factor is set to 1.0. Workload is held constant in this comparison, and the only issue is whether a given increment in workload can be produced at higher or lower cost in MTFs versus CHAMPUS. Next, the tradeoff factor is relaxed to a larger value, more consistent with empirical experience. Because demand increases, costs will increase beyond the level estimated for a unitary tradeoff factor. However, this latter increase does not reflect an efficiency comparison, because total workload is no longer held constant.

These principles will now be illustrated in a series of numerical examples.

1. Equal Marginal Costs

In the first example, the two sectors have equal marginal costs of $10 per visit. However, the cost functions in Figure IV-1 have been drawn such that the intercept is higher by $100 in MTFs.

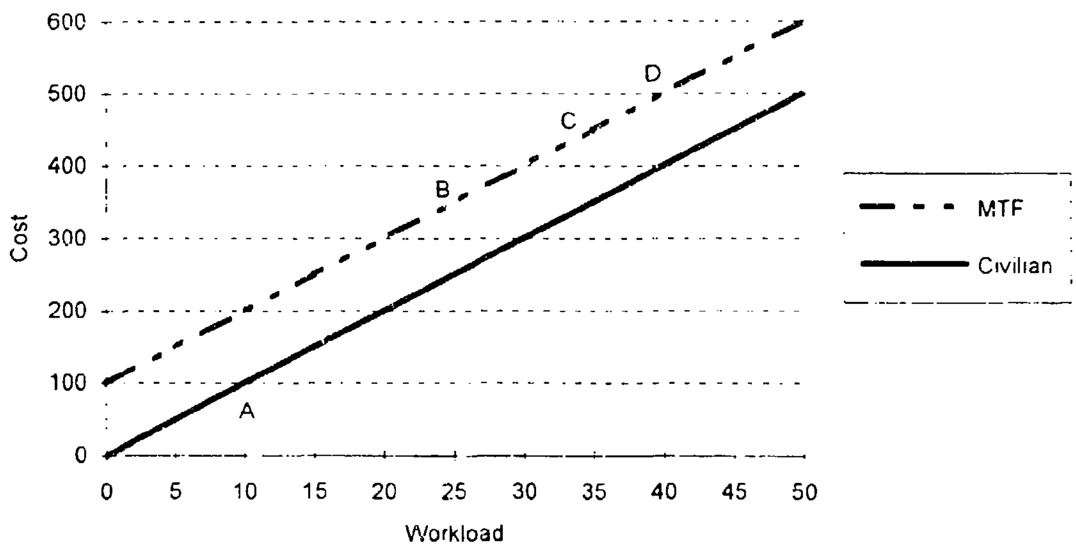

Figure IV-1. Cost and Workload: Equal Marginal Costs

Suppose Case 1 has workloads of 10 visits to civilian physicians under CHAMPUS, and 25 visits to MTFs. The respective costs are $100 and $350 (points A and B). Case 2 moves workload from CHAMPUS back into the MTFs. We decompose the

total movement into two effects. First, we fix the tradeoff factor at exactly 1.0. Thus, the 10 CHAMPUS visits are replaced by *exactly* 10 MTF visits. The new total of 35 MTFs visits costs \$450 (point C). Total cost does not change, because the marginal cost of reduced CHAMPUS workload equals the marginal cost of increased MTF workload.

Now introduce a tradeoff factor $\Theta = 1.5$. The 10 CHAMPUS visits are now replaced with 15 MTF visits, and total cost increases to \$500 (point D).

2. Unequal Marginal Costs

In the second example, the intercept is still higher by \$100 in MTFs In addition, the marginal cost per visit in MTFs is now higher as well, \$12 versus \$10. These values are reflected in the two cost curves shown in Figure IV-2.

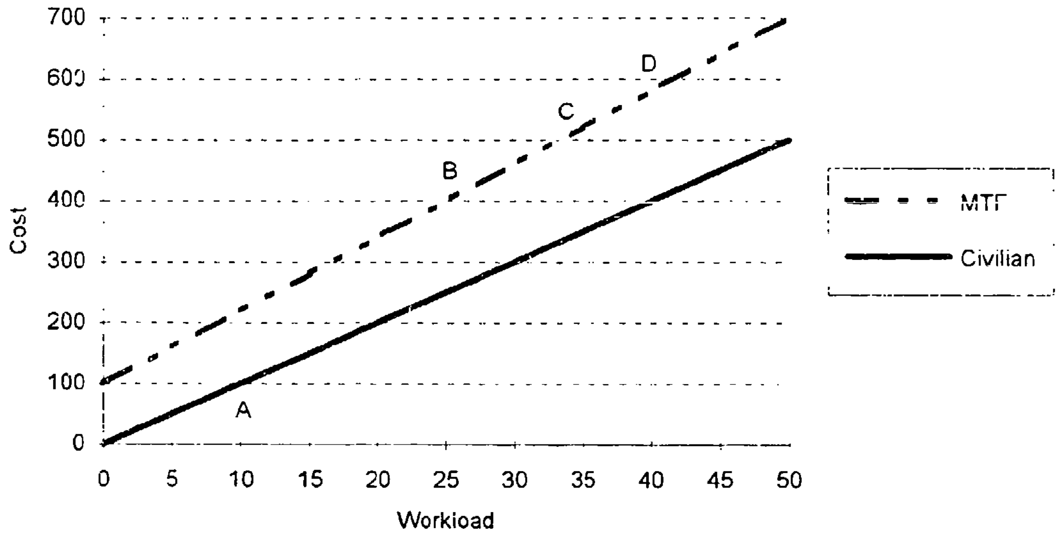

Figure IV-2. Cost and Workload: Unequal Marginal Costs

Case 1 still has workloads of 10 visits to civilian physicians under CHAMPUS, and 25 visits to MTFs. The respective costs are \$100 and now \$400 (points A and B). Case 2 moves workload from CHAMPUS back into the MTFs. We again decompose the total movement into two effects. First, we fix the tradeoff factor at exactly 1.0. Thus, the 10 CHAMPUS visits are replaced by *exactly* 10 MTF visits. The new total of 35 MTFs visits costs \$520 (point C). Total cost has increased by \$20, because the 10 marginal units are being performed at a higher marginal cost (\$12 versus \$10 each).

Now introduce a tradeoff factor $\Theta = 1.5$. The 10 CHAMPUS visits are now replaced with 15 MTF visits, and total cost increases further to \$580 (point D).

3. Diminishing Marginal Costs

In our final example, we introduce a quadratic term into the MTF cost function, to represent diminishing marginal costs (i.e., increasing returns).[1] Thus, the MTF cost function is drawn as concave to the origin in Figure IV-3. MTF costs equal \$400 at 25 visits (point B) but, because of the non-linearity, only \$510 at 35 visits (point C). Marginal cost declines continuously from \$12 to \$10 over this range. Total cost equals \$558 at 40 visits (point D), the workload resulting from application of the tradeoff factor, $\Theta = 1.5$.

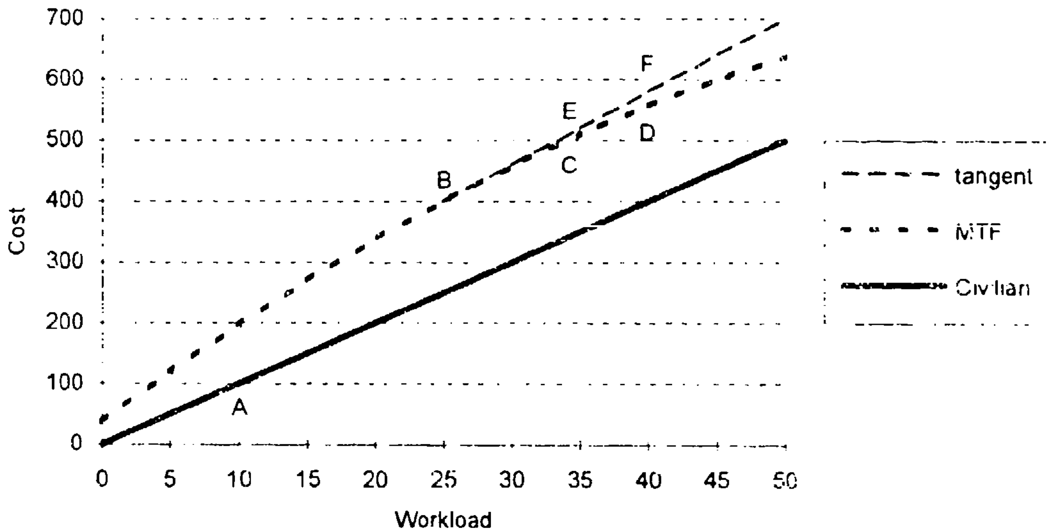

Figure IV-3. Cost and Workload: Diminishing Marginal Costs

The only danger here is extrapolating MTF costs along the tangent line, with fixed slope of \$12 (i.e., the marginal cost at a workload of 25 visits). We would over-estimate MTF costs at \$520 (point E) for a tradeoff factor of $\Theta = 1.0$, and at \$580 (point F) for a tradeoff factor of $\Theta = 1.5$.

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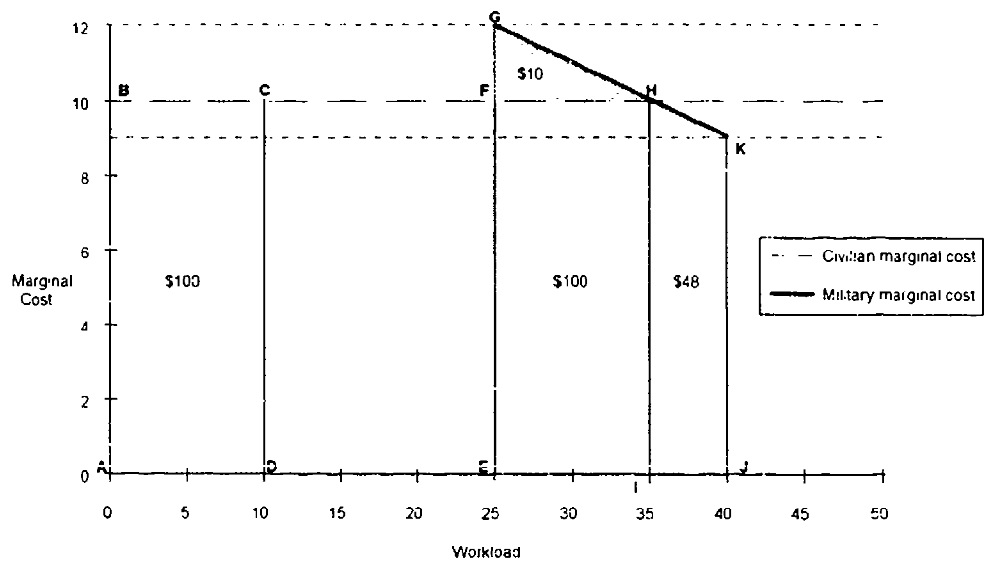
1 The cost function for this example is: $C = 37.57 + 17.0\ X - .10\ X^2$. Quadratic functions of this form were reported in Chapter III, although the coefficients in this example purely illustrative.

4. Efficiency and Demand Effects

It is illuminating to analyze the previous example using marginal cost curves. The marginal cost curve for visits to civilian physicians (curve BCFH in Figure IV-4) is horizontal at $10, reflecting perfectly elastic supply in a competitive medical market. Over the range of interest, the marginal cost curve for visits to MTFs (curve GHK) declines continuously from $12 at 25 visits, to $10 at 35 visits, to $9 at 40 visits.



Note: Triangle FGH = efficiency effect; trapezoid HIJK = demand effect.

Figure IV-4. V rkload Shift from Civilian to Military Sector: Efficiency and Demand Effects

Consider first the transfer of 10 visits from civilian physicians to MTFs, which occurs when we set the tradeoff factor Θ=1.0. Costs incurred in the civilian sector decrease by $100, depicted on the diagram by the rectangle ABCD. Cost incurred in MTFs increase by $110. This increase is depicted by the area under the MTF marginal-cost curve over the interval from 25 to 35 visits, or the trapezoid EFGHI. The net increase in cost is equal to EFGHI minus ABCD, or just the triangle FGH. We label this triangle the *efficiency effect*.

Now relax the tradeoff factor to Θ = 1.5. MTFs now provided an additional five visits. The cost of these five visits is $48, depicted by the area under the MTF marginal-cost curve over the interval from 35 to 40 visits, or the trapezoid HIJK. Note that MTFs

are actually more efficient than the civilian sector over this range, so that the increased cost does *not* reflect an efficiency loss. Instead, we label this trapezoid the *demand effect*.

Both the efficiency and demand effects must be weighed in assessing the overall cost-effectiveness of increasing MTF capacity. The efficiency effect represents an increase in cost in our example, but one could just as easily construct examples where the efficiency effect represents a decrease in cost. In either instance, the efficiency effect must be balanced against the demand effect, which necessarily entails an increase in cost. The net effect on total cost may be of either algebraic sign. Moreover, the sign of the net effect is not by itself sufficient to judge the cost-effectiveness of increasing MTF capacity. Beneficiary health-status may improve with the increase in health-care utilization. In addition, the shift from CHAMPUS to MTFs leads to a reduction in beneficiary co-payments, again affecting beneficiary well-being. To account for all of these issues requires a combination of the MTF cost estimates presented later in this chapter, plus the companion RAND analyses of utilization and civilian-sector costs.

B. DESCRIPTION OF THE ANALYTICAL CASES

The analytical cases are fully developed in a companion RAND publication.[2] It is not our purpose here to describe either the rationale behind each case, or the method of workload estimation. Instead, we give a summary description of the analytical cases in this section, then estimate the in-house cost under each case in the following section.

Case 1 is a minor excursion from the historical FY92 data as reported in MEPRS. The difference reflects managed-care initiatives that had not yet been fully implemented during that year. As shown in Table IV-1, the system-wide difference is an increase of 1.9% in the number of inpatient dispositions, and 0.1% in the number of ambulatory visits. However, as shown in Figures IV-5 and IV-6, these increases in workload are not uniformly distributed across MTFs. Inpatient dispositions rise at every MTF, but the increases range from about 0.5% to slightly over 4%. Ambulatory visits actually fall at 44 MTFs, although the largest decrease is only about 0.5%.

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2 Susan D. Hosek, Bruce W. Bennett, Kimberly A. McGuigan, Jan M. Hanley, Roger Madison, and Afshin Rastegar, "The Demand for Military Health Care: Supporting Research for a Comprehensive Study of the Military Health Care System," RAND Corporation, MR-407-PA&E, January 1994.

Table IV-1. Summary of Analytical Cases

	MEPRS FY92 Actual	Case 1	Case 2C	Case 2
Inpatient Dispositions:				
Number (thousands)	715.9	729.4	776.5	856.3
Ratio to FY92 Actual	1.000	1.019	1.085	1.196
Ambulatory Visits:				
Number (millions)	37.96	38.01	40.04	40.90
Ratio to FY92 Actual	1.000	1.001	1.055	1.078

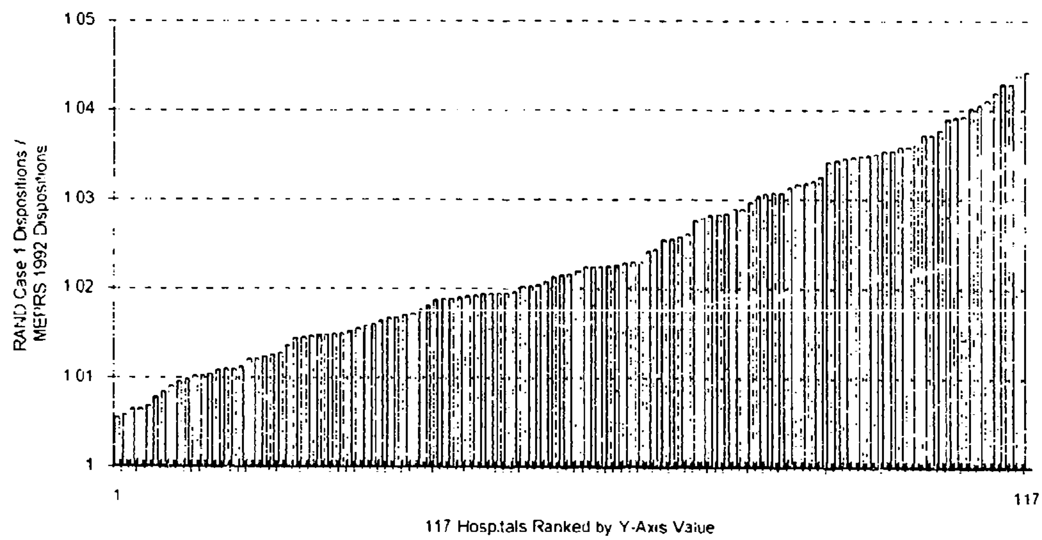

Figure IV-5. Comparison of Case 1 and MEPRS Inpatient Dispositions

Cases 2 and 2C involve an increase in MTF capacity, so some portion of CHAMPUS workload is drawn into the MTFs. Capacity expansion is reflected in the addition of 878 operating beds spread over some 15 facilities, as displayed in Table IV-2. Note that 94 of these operating beds are associated with construction of a new hospital at Ft. McPherson, based on the size of the beneficiary population in that region.

The sole difference between Cases 2 and 2C is in the implicit tradeoff factor. Case 2C artificially sets the tradeoff factor at $\Theta = 1.0$. Relative to our earlier terminology, the movement from Case 1 to Case 2C isolates a pure efficiency effect, because the total (MTF plus CHAMPUS) workload is held constant. Note, however, that IDA has estimated only the increased *in-house* cost associated with the influx in MTF workload. A

complete analysis of the efficiency effect also requires an estimate of the reduced CHAMPUS cost, in order to compute the net effect on total cost. The CHAMPUS cost estimates are found in the previously cited RAND Corporation publication. Finally, the movement from Case 2C to Case 2 represents the demand effect, because the tradeoff factor is no longer artificially set at $\Theta = 1.0$. Instead, the RAND utilization analysis implicitly allows a greater than one-for-one transfer of workload into MTFs.

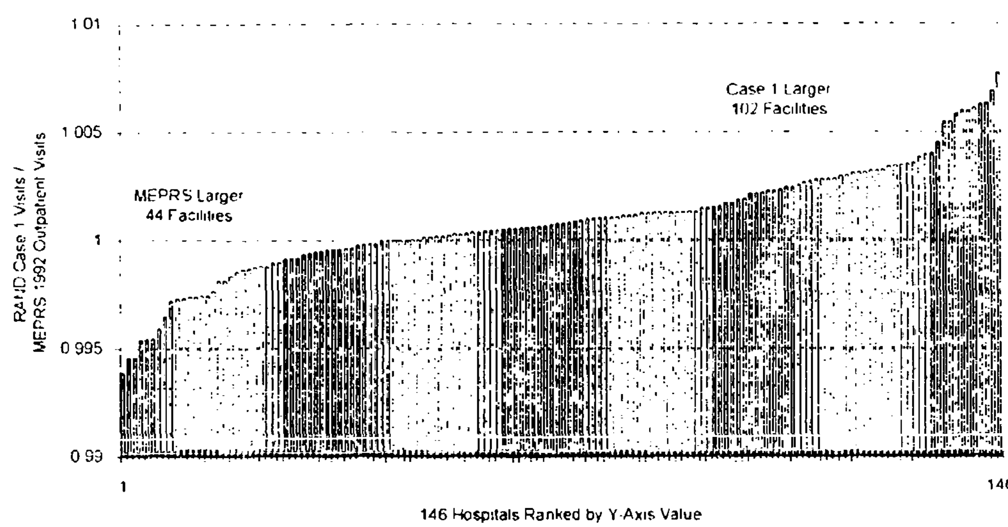

Figure IV-6. Comparison of Case 1 and MEPRS Ambulatory Visits

Table IV-1 shows the system-wide differences among all the cases. Compared to historical FY92 data, Case 2C shows an increase of 8.5% in the number of inpatient dispositions, and 5.5% in the number of ambulatory visits. Case 2 is a larger departure from history, with increases of 19.6% in the number of inpatient dispositions and 7.8% in the number of ambulatory visits. Again, the increases in workload are not spread uniformly across MTFs. The distributions of workload increase by MTF are shown in Figures IV-7 and IV-8 for Case 2C, and Figures IV-9 and IV-10 for Case 2. Workload rises at virtually every MTF, but the percentage increases are quite variable. In particular, ten MTFs experience a doubling or more of inpatient dispositions under Case 2.

Table IV-2. Additional Operating Beds Under Cases 2 and 2C

MTF	State	FY92 Actual Operating Beds	Case 2/Case 2C Operating Beds	Increase in Operating Beds
MacDill AFB	FL	55	170	115
Ft. Dix	NJ	36	145	109
Mather AFB	CA	35	115	80
Ft. Bragg	NC	206	283	77
Tinker AFB	OK	25	89	64
Patrick AFB	FL	15	77	62
Nellis AFB	NV	35	91	56
NH Long Beach	CA	166	217	51
Davis Monthan AFB	AZ	35	72	37
Ft. Eustis	VA	42	78	36
March AFB	CA	80	111	31
Offutt AFB	NE	50	81	31
Ft. Lee	VA	52	73	21
Carswell AFB	TX	100	114	14
			Subtotal:	784
Ft. McPherson	GA	0	94	94
			Total:	878

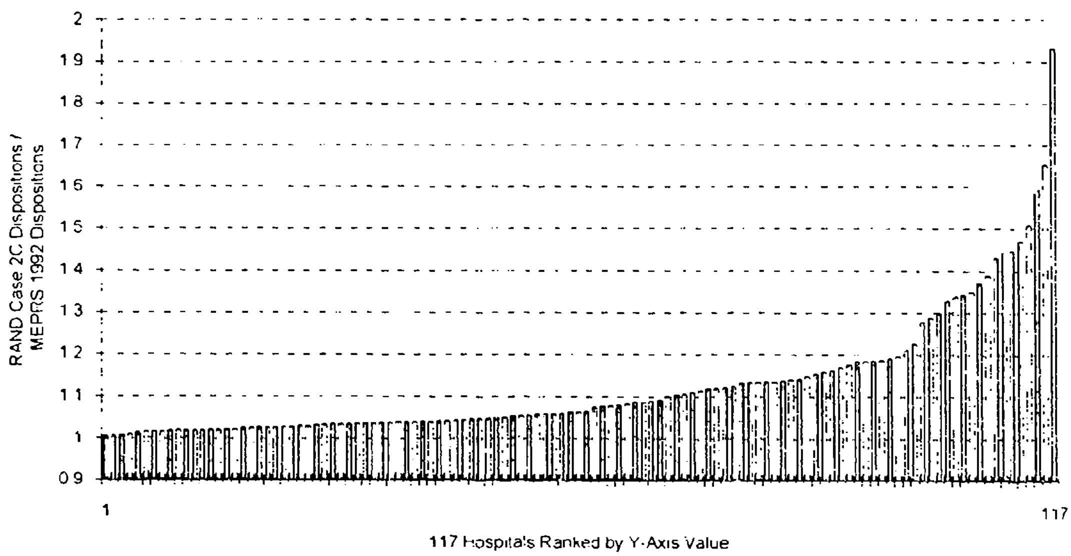

Figure IV-7. Comparison of Case 2C and MEPRS Inpatient Dispositions

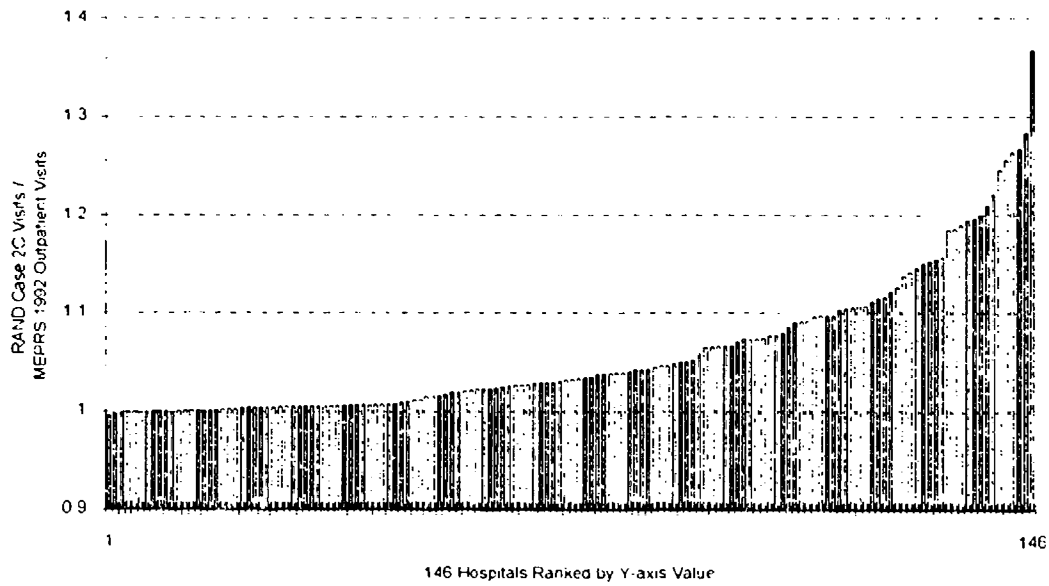

Figure IV-8. Comparison of Case 2C and MEPRS Ambulatory Visits

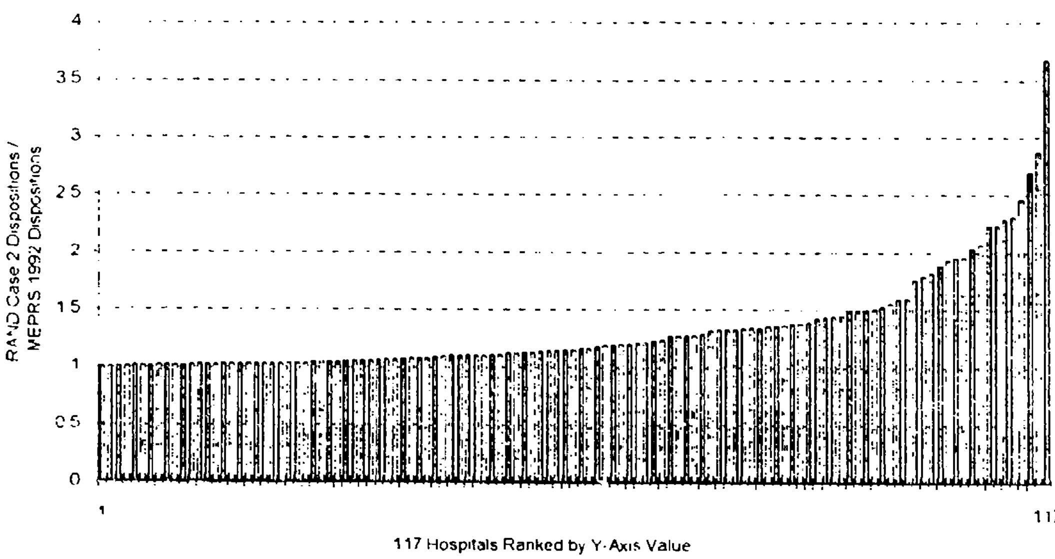

Figure IV-9. Comparison of Case 2 and MEPRS Inpatient Dispositions

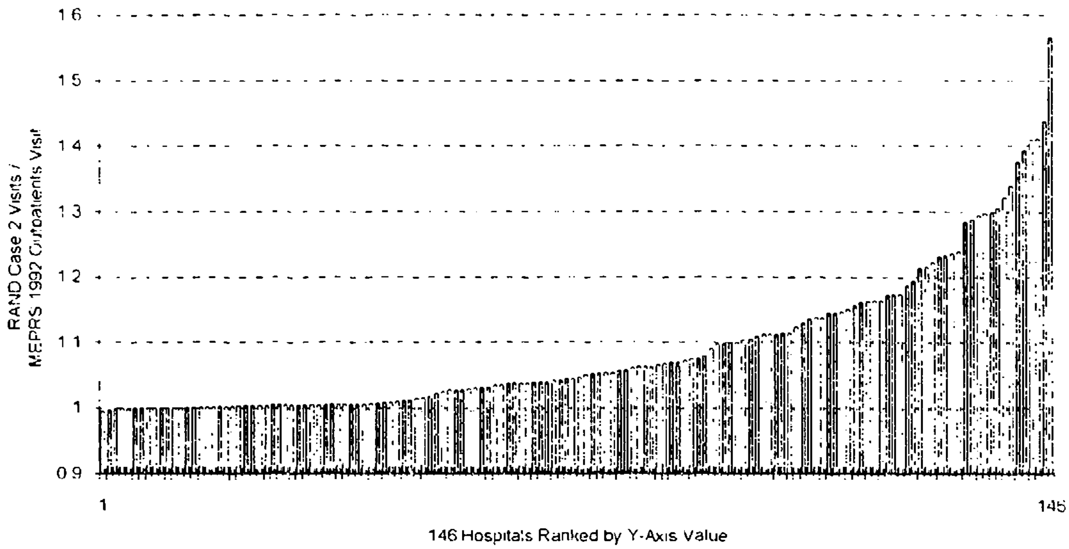

Figure IV-10. Comparison of Case 2 and MEPRS Ambulatory Visits

C. ESTIMATION OF MTF COSTS FOR THE ANALYTICAL CASES

We estimated the MTF costs for the analytical cases by substituting the RAND workload projections into the cost functions developed in Chapter III. Recall that the RAND workload projections are based on models calibrated from the 1992 DoD Health Care Survey. However, these workloads are measured along a different scale from the MEPRS workloads used in estimating the IDA cost functions. The exchange rates (illustrated in Figure III-7) were used to translate workloads from one scale to the other. The use of exchange rates is valid on the assumption that the historical relationships between the two measurement systems will be maintained under the analytical cases.

The detailed cost estimates are shown in Table IV-3, and a summary is displayed in Figure IV-11. The "MEPRS FY92 Reported" column in the table shows reported inpatient and ambulatory costs for FY92. The "MEPRS FY92 Adjusted" column represents an application of the MEPRS adjustment factors developed in Chapter II (Figure II-7). This column gives a more accurate and comprehensive estimate of historical costs than that found in the standard reporting systems.

Table IV-3. Cost Breakout by Analytical Case

		MEPRS FY92 Reported	MEPRS FY92 Adjusted	Case 1	Case 2C	Case 2
Inpatient						
Army	Medical Center	688.4	799.9	853.0	865.3	883.8
	Hospital	393.7	457.5	471.3	508.4	538.3
Air Force	Medical Center	383.7	432.5	456.0	463.7	478.2
	Hospital	335.7	378.3	372.6	419.8	474.2
Navy	Medical Center	373.4	420.8	418.7	419.9	422.7
	Hospital	236.8	266.9	291.6	305.7	332.9
Inpatient Total		2,411.7	2,755.9	2,863.1	2,982.7	3,130.1
Ambulatory						
Army	Medical Center	527.9	593.9	584.3	591.0	594.1
	Hospital	696.6	783.7	775.1	826.8	838.7
	Clinic	19.0	21.4	17.6	17.6	17.6
Air Force	Medical Center	295.8	326.9	312.7	317.9	320.4
	Hospital	658.9	728.1	706.6	795.7	786.0
	Clinic	98.1	108.3	110.8	114.3	116.1
Navy	Medical Center	362.4	400.8	335.1	336.0	336.4
	Hospital	457.7	506.2	486.1	510.1	522.9
	Clinic	81.7	90.4	93.6	93.9	93.9
Ambulatory Total		3,198.1	3,559.6	3,421.9	3,567.3	3,626.2
Total Cost		5,609.8	6,315.5	6,284.9	6,549.9	6,756.3

Note: Costs are in millions of FY92 dollars.

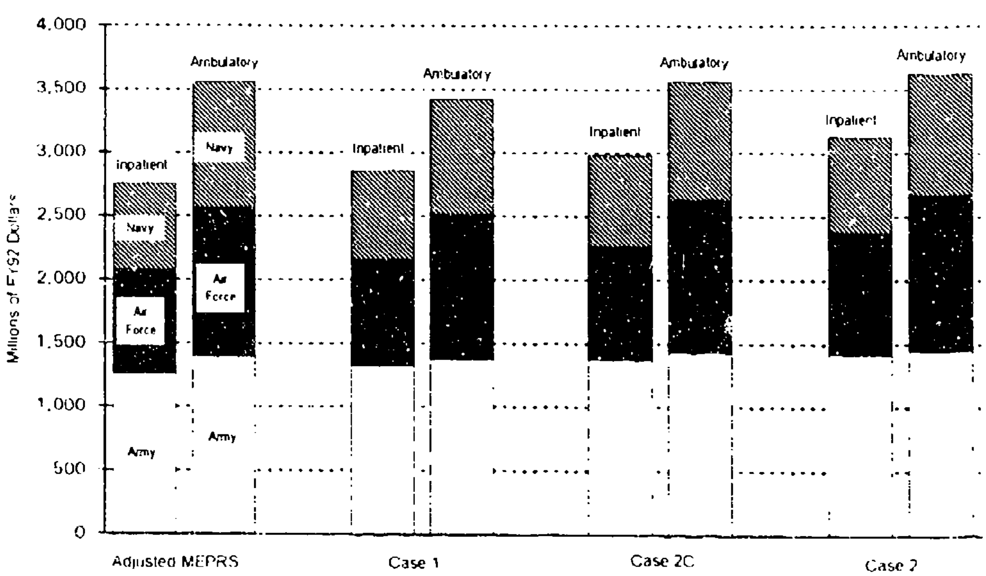

Figure IV-11. Cost Breakout by Analytical Case

The increased in-house cost of moving from Case 1 to Case 2C is $265 million or 4.2%. Computation of the net change in total cost requires an estimate of the corresponding reduction in CHAMPUS cost, which is found in the RAND Corporation publication. The full movement to Case 2 incorporates the demand effect as well as the efficiency effect. The additional increase in MTF cost is $206 million or 3.2%. The overall increase is relatively small, because it represents the net addition of only 878 operating beds system-wide.

The MTF costs from the "MEPRS FY92 Adjusted" column of Table IV-3 may be added to the CHAMPUS costs estimated by RAND, giving an indication of total peacetime medical costs during that fiscal year. This sum is necessarily smaller than the total medical cost in Major Force Program 8 of the Future Years Defense Program (FYDP), because certain program elements relate to wartime readiness or other missions apart from peacetime care. This point is explored in Table IV-4. The selection and classification of Program Elements (PEs) is based on the OASD (Health Affairs) Cost of Medical Activities (COMA) Data Book, with minor modifications.[3] One difference is that we display the FYDP total from all appropriations, whereas the COMA report concentrates on the Operations and Maintenance (O&M) appropriation. The four PEs in the category "PEs Used in IDA Adjustments to MEPRS" approximate the adjustments described previously in Chapter II. However, those adjustments were based on FY90 data, whereas the current table is based on FY92 data. Note that PEs 0807716 (Medical Facilities, Planning and Design) and 0807717 (Medical Facilities, Military Construction) are included here to proxy for the construction-cost adjustment to MEPRS. These two PEs do not appear in the COMA report, because they are funded outside of the O&M account.

It is impossible to develop a complete reconciliation between MEPRS and the FYDP, partly because FYDP obligations translate into outlays over a multi-year time window. In addition, there is no standard crosswalk between MEPRS and any particular subset of PEs, nor is it our intention to create such a crosswalk here.[4] Finally, the IDA adjustments include both a reallocation of costs reported within MEPRS (i.e., factoring

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[3] *Defense Health Program, Data Book, Fiscal Year 1994, Cost of Medical Activities*, Office of the Assistant Secretary of Defense (Health Affairs), 1993.

[4] A partial crosswalk for the Air Force is given in Air Force Regulation 170-5 (15 May 1992). However, there are no corresponding regulations for the other two Services. Moreover, even the Air Force regulation does not address adjustments for cost elements excluded from MEPRS (e.g., as reflected in the OSD program elements).

back some of the Special Programs accounts), and the addition of costs omitted from MEPRS (e.g., management headquarters).

Table IV-4. Reconciliation of FY92 Medical Obligations in Major Force Program 8

Category	Program Element	Description	Funding	Subtotal	Cumulative FYDP Total	MEPRS Reported, Excluding Dental	MEPRS Adjusted, Excluding Dental
Patient Care, Excluding Dental	0807711	Care in Regional Defense Facilities	$2,317,862				
	0807792	Station Hospitals and Medical Clinics	$3,936,866				
				$6,254,728	$6,254,728		
Base Support	0807756	Environmental Compliance	$5,818				
	0807776	Minor Construction, Health Care	$2,661				
	0807778	Maintenance and Repair, Health Care	$52,165				
	0807790	Visual Information Activities	$9,513				
	0807795	Base Communications, Health Care	$30,952				
	0807796	Base Support, Health Care	$564,563				
				$665,672	$6,920,400	$5,609,788	
PEs Used in IDA Adjustments to MEPRS	0807716	Medical Facilities, Planning & Design	$40,623				
	0807717	Medical Facilities, Military Construction	$230,600				
	0807791	Defense Medical Program Activity	$116,705				
	0807798	Management Headquarters, Medical	$50,065				
				$437,993	$7,358,393		$6,315,506
CHAMPUS	0807712	CHAMPUS	$3,763,999				
				$3,763,999	$11,122,392		

Table IV-4. Reconciliation of FY92 Medical Obligations in Major Force Program 8 (Continued)

Category	Program Element	Description	Funding	Subtotal	Cumulative FYDP Total	MEPRS Reported, Excluding Dental	MEPRS Adjusted, Excluding Dental
Dental	0807715	Dental Care Activities	$616,093				
				$616,093	$11,738,485		
Education and Training	0806721	Uniformed Services University of the Health Sciences (USUHS)	$80,330				
	0806722	Armed Forces Scholarship Program	$97,079				
	0806764	Education and Training, Health Care	$907,561				
				$1,084,971	$12,823,456		
Other Patient Care Support	0801712	Examining Activities	$23,522				
	0807713	Care in Non-Defense Facilities	$519,910				
	0807714	Other Health Activities	$1,050,164				
				$1,593,596	$14,417,051		

Note: Costs are in thousands of FY92 dollars

With these qualifications, the cumulative FYDP total for "Patient Care, Excluding Dental" plus "Base Support" should approximate the "MEPRS Reported, Excluding Dental." In fact, the former ($6.92 billion) is 23.4% larger than the latter ($5.61 billion). Similarly, the cumulative FYDP total including "IDA Adjustments to MEPRS" should approximate the "MEPRS Adjusted, Excluding Dental". In this case, the former ($7.36 billion) is 16.5% larger than the latter ($6.32 billion). The reduction in the discrepancy when looking at the *adjusted* subtotals is some indication that the adjustment is working in the correct direction.

Further adding the RAND estimate of CHAMPUS expenses should approximate the cumulative FYDP total of $11.12 billion. Even this figure falls short of the Program 8 total of roughly $14 billion, because the latter includes Dental Care Activities, Examining Activities, Care in Non-Defense Facilities (i.e., supplementary care), Other Health Activities, and training activities not already subsumed in the other PEs. We treat these activities as "below the line," and we do not attempt to model them with even the adjusted

MEPRS data. Rather, they should be added back to the sum of the IDA and RAND estimates for any analytical cases under consideration. If these activities are expected to change under an analytical case, then that calculation should be conducted independently of either the IDA or RAND cost analyses.

Program Element 0807714 (Other Health Activities) includes, among other things, spending for wartime contingencies. A portion of this PE may correlate to the MEPRS F accounts, though not to any of the three-digit peacetime-related F accounts identified for the MEPRS adjustments in Chapter II. Also as discussed in Chapter II, we treat PE 0806721 [Uniformed Services University of the Health Sciences (USUHS)] and PE 0806722 (Armed Forces Scholarship Program) as "below the line," because they do not represent patient care provided in MTFs. The costs of these two PEs are held constant in the analytical cases compared in this paper, and do not contribute to the differences between the c[illegible].

Finally, PE 0806761 (Education and Training, Health Care) is a catch-all account that is difficult to fully reconcile with MEPRS. For students being trained at MTFs (as opposed to USUHS or civilian hospitals), salary expenses are captured either in MEPRS account FAK (Student Expenses) or else directly in the Inpatient or Ambulatory accounts. Expenses other than student salaries (e.g., instructor salaries, medical library, medical illustration and medical photography) are reported in MEPRS accounts EBE (Graduate Medical Education Support) and EBF (Education and Training Support). Accounts EBE, EBF, and FAK may correlate to PE 0806761, but the data systems are not adequate to allow complete reconciliation of the dollar totals.

D. ADDITIONAL ANALYTICAL CASES

The analytical cases considered in this chapter involve an increase in MTF capacity. Future analysis will consider cases that reduce MTF capacity as well. For those cases, care must be exercised to preserve sufficient capacity to meet the wartime medical requirements. The wartime requirements specify not only numbers of CONUS evacuation beds, but also numbers of physicians (by specialty) to treat casualties and disease non-battle injuries (DNBI) in the theater. The CONUS hospitals must be configured in peacetime with enough billets to occupy all of the wartime-required physicians that will be drawn from the Active Component. In addition, the beneficiary population served by the

remaining CONUS hospitals must supply enough clinical material to keep these physicians fully trained. The construction of analytical cases along these lines is now underway, and the cost estimates will be provided in the near future.

V. CONCLUSIONS AND AGENDA FOR FUTURE RESEARCH

This paper has used MEPRS data to model the relationship between cost and workload at military hospitals. Prior to estimating the models, we adjusted the MEPRS data to include the same set of cost elements that would be reflected in the prices charged by civilian-sector providers. These adjustments ranged between 10.6% and 16.9%, depending on the Service branch and the type of care (i.e., inpatient or ambulatory).

In developing the adjustment factors, we concluded that the Service comptroller pay factors used in MEPRS are too low for physicians, but too high for nurses, MSC officers, and medical enlisted personnel. Although these errors average out to zero in the aggregate, they impart a bias in the relative costs of the various categories of personnel. For certain purposes, such as determining the optimal mix of personnel by category, it would be preferable to use the medical-specific pay factors developed in this paper. Further research may be desirable to assess the impact of using alternative pay factors in making decisions on staffing mix.

We developed regression models to predict cost as a function of the inpatient and ambulatory workloads, the number of operating beds, and the level of GME provided at each MTF. The facility-level costs can then be summed to predict the system-wide costs of in-house medical care. Corresponding cost estimates for care provided in the civilian sector are being prepared by the RAND Corporation.

Several difficulties were encountered in developing the regression models. Foremost, inpatient discharges were case-mix adjusted using CHAMPUS Version 8 DRG weights. This procedure was necessary to account for the differences across clinical areas in resource intensity. The use of DRG weights enabled us to form a homogeneous work unit for inpatient care at each MTF. Moreover, the case-mix adjustment enabled us to combine data from medical centers with data from community hospitals. These two sources of data would be incommensurable without a case-mix adjustment, because community hospitals refer many of their most difficult cases to medical centers.

By using CHAMPUS DRG weights, we assume that the relative cost by DRG based on CHAMPUS experience provides a good predictor of the relative cost by DRG in military hospitals. Further research may be necessary to investigate the validity of this assumption, and to explore alternative methods of case-mix adjustment. Additional research may also be required to develop corresponding measures of resource intensity for ambulatory care.

Another difficulty involved correcting for the escalation in unit cost observed at MTFs between FY90 and FY92. The two-year cumulative escalation rates ranged between 15.2% and 27.3%, depending on the type of facility (i.e., medical center, community hospital, or ambulatory clinic) and the type of care (i.e., inpatient or ambulatory). These escalation rates cannot be strictly interpreted as price indices for medical care, because rapid technological advance invalidates the concept of comparing prices for a constant set of goods or services. Nonetheless, the escalation rates are surprisingly high, and merit further investigation.

We estimated the costs associated with GME programs at military hospitals. Our estimates include student salaries, as recorded both directly in classroom time and indirectly in patient-care time. Our estimates also include instructor salaries, plus some miscellaneous expenses incurred at teaching hospitals such as medical library, medical illustration, and medical photography. We find that each additional enrolled resident or intern adds nearly $170,000 in total to these elements of hospital cost. More research would be desirable to both improve the accounting of GME costs at military hospitals, and to assess the cost-effectiveness of military GME programs.

In developing the regression models, we encountered difficulties in comparing cost and workload data across the three Services. In particular, unit cost as computed from MEPRS data appears to be higher for the Navy than for the Army or the Air Force. Insight into this result was provided by examining the ratios between workload as reported in MEPRS, and workload as estimated from the 1992 DoD Health Care Survey. More workload is reported in MEPRS than in the survey, but the difference is less pronounced for the Navy than for the other two Services. Thus, MEPRS may understate Navy workload (or overstate it less), fostering the appearance of higher unit cost for the Navy. Although MEPRS purports to be a standardized accounting system, further research may be warranted to improve the comparability of data across the Services.

The ratios between MEPRS-based and survey-based workload were also important in the interaction between the IDA and RAND elements of the Section 733 Study. RAND projected hypothetical inpatient and ambulatory workloads under two analytical cases. The RAND projections were based on models calibrated from the 1992 DoD Health Care Survey. The IDA cost models, however, were estimated from MEPRS data on cost and workload. A conversion was necessary to make the RAND workloads fit into the IDA cost models. The conversion factors, or "exchange rates," were computed by RAND along various dimensions such as inpatient versus ambulatory care, beneficiary category, and Service branch. Additional research may be justified to improve the process of combining accounting-system data with self-reported survey data.

Both of the analytical cases considered thus far have involved an increase in system-wide MTF capacity. The two cases differ in the assumed response of beneficiaries to the greater availability of MTF care. The second case recognizes that total medical workload is likely to increase, because co-payments are lower for care provided at MTFs than for care purchased through CHAMPUS. This paper reports estimates of the increased in-house cost associated with the two analytical cases. Estimates of the corresponding reductions in CHAMPUS cost, which are necessary for computing the net change in total cost, are reported in a RAND Corporation publication.

Subsequent analysis will consider analytical cases that reduce MTF capacity as well as those that increase it. Those cases are currently being constructed, and the cost estimates will be provided in the near future.

ABBREVIATIONS

ABBREVIATIONS

AFB	Air Force Base
AMC	Army Medical Center
BuMed	Bureau of Medicine and Surgery
CHAMPUS	Civilian Health and Medical Program of the Uniformed Services
COMA	Cost of Medical Activities
CONUS	continental United States
DBOF	Defense Business Operations Fund
DMDC	Defense Manpower Data Center
DMFO	Defense Medical Facilities Office
DMSSC	Defense Medical Systems Support Center
DNBI	disease non-battle injuries
DoD	Department of Defense
DRG	Diagnosis Related Group
FTE	full-time equivalent
FY	fiscal year
FYDP	Future Years Defense Program
GME	Graduate Medical Education
HCFA	Health Care Financing Administration
IDA	Institute for Defense Analyses
JUMPS	Joint Uniformed Military Payroll System
MEPRS	Medical Expense and Performance Reporting System
MilPers	military personnel
MSC	Medical Service Corps
MTF	Military Treatment Facility
NH	Naval Hospital
NNMC	National Naval Medical Center
O&M	Operations and Maintenance

OASD	Office of the Asistant Secretary of Defense
OASD(P&R)	Office of the Assistant Secretary of Defense (Personnel and Readiness)
OCONUS	outside the continental United States
OD(PA&E)	Office of the Director (Program Analysis and Evaluation)
OSD	Office of the Secretary of Defense
P&D	planning and design
P&R	Personnel and Readiness
PA&E	Program Analysis and Evaluation
PE	Program Element
RPMA	real property maintenance activity
TAD	temporary additional duty
TDY	temporary duty
UMC	unspecified minor construction
USUHS	Uniformed Services University of the Health Sciences